FINAL REPORT

VINELAND CHEMICAL SUPERFUND SITE: PERIODIC SAMPLING – SPRING 2010 OPERABLE UNITS #3 AND #4 VINELAND, NEW JERSEY

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February 2011 EA Project No. 62305.01

123652

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LIST OF ABBREVIATIONS, ACRONYMS, AND UNITS

ADR	Automated Data Review
ASTM	American Society for Testing and Materials
ºC	Degrees Celsius
COC	Chain of Custody
DESA	Division of Environmental Science and Assessment
DGPS	Differential Global Positioning System
EA	EA Engineering, Science, and Technology, Inc.
EDDs	Electronic Data Deliverables
EM	Engineer Manual
ft	Foot/Feet
HNO_3	Nitric acid
in	Inch(es)
MDL	Method Detection Limit
mg/Kg	Milligram(s) Per Kilogram (ppm)
mg/L	Milligram(s) Per Liter
mL	Milliliter(s)
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NAD83	North American Datum 1983
NJ	New Jersey
ND	Non-detect
ppb	Part(s) Per Billion (µg/kg or µg/L)
ppm	Part(s) Per Million (mg/Kg or mg/L)
ppt	Part(s) Per Thousand (g/kg or g/L)
QA	Quality Assurance
QC	Quality Control
RL	Reporting Limit
ROD	Record of Decision
SOP	Standard Operating Procedure
µg/L	Microgram(s) Per Liter (ppb)
µm	Micrometer(s)

USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency

EXECUTIVE SUMMARY

The Vineland Chemical site is a 54-acre manufacturing facility located in Cumberland County, New Jersey (NJ) (Figure ES-1). The facility was involved in the production of arsenical herbicides, fungicides, and biocides since 1949. Arsenical feedstock compounds were historically stored in unprotected piles that resulted in soil and groundwater contamination in the vicinity of the site. Runoff during storm events and the recharge of arsenic-bearing groundwater has contaminated the adjacent watershed, including soil, sediment, and surface waters of nearby waterways such as Blackwater Branch, Maurice River, and Union Lake (Figure ES-1). Four long-term, remedial phases at the site focus on source control, migration management, and cleanup of the rivers and Union Lake sediments, which was the subject of a Record of Decision (ROD) in 1989 (USEPA 1989). Two general areas of consideration for the study include public health and remedial actions. The current phase of remediation at the site involves removing the contaminated soils/sediments of the Blackwater Branch and the floodplain east of Mill Road and adjacent to the site. This excavation has the potential to stir up sediments and impact the waterways downstream. A monitoring program has been initiated that includes baseline (pre-excavation) sampling, during excavation/construction sampling, and post-construction sampling to determine the status of exposure and impacts to human health exposure pathways. The first survey, the May 2006 Baseline Sampling, was conducted prior to the initiation of planned remedial excavation activities in the Blackwater Branch (EA 2006a). The second survey, the November 2006 Periodic Sampling, was conducted during excavation activities at the site. The third survey, the September 2007 Post Remedial Action Sampling, was conducted following the completion of excavation for remedial action activities. The fourth survey, Periodic Sampling – Spring 2009, was completed in May 2009; at that time remediation activity was occurring on the west side of Mill Road. The fifth survey, Periodic Sampling – Fall 2009, was conducted in November 2009; remediation activity was being completed on the west side of Mill Road and at the Route 55 area. The sixth survey, Periodic Sampling – Spring 2010, was conducted in April and May 2010. As with the Fall 2009 sampling, remediation activity was being completed on the west side of Mill Road and at the Route 55 area.

This report presents the results of the sixth survey, Spring 2010 Periodic Sampling, that was conducted in April and May 2010. The Periodic Sampling was designed to identify, analyze, and evaluate the arsenic concentrations in sediments, soil, and surface water collected at ten locations in and near waterways located adjacent to the site following the Blackwater Branch excavation activities. The April/May 2010 sampling also included additional transect sampling at the five beach locations where recreational swimming occurs during the summer bathing season. EA Engineering, Science, and Technology, Inc. (EA) was contracted by the U.S. Army Corps of Engineers (USACE) - Philadelphia District to conduct sediment, soil, and surface water sampling at ten locations along Blackwater Branch, the Maurice River, and Union Lake. The arsenic concentration in each of the samples was measured by the U.S. Environmental Protection Agency (USEPA) Region II Laboratory located in Edison, New Jersey. The *Uniform Federal Policy/Quality Assurance Project Plan* (*UFP/QAPP*) *for Vineland Chemical Superfund Site* (USACE 2009) described the sampling and data-gathering methods for the project and followed guidance provided by the USACE Engineer Manual (EM) 200-1-3 *Requirements for Preparation of Sampling and Analysis Plans* (2001).

The following types of samples were collected and analyzed for arsenic during the Periodic Sampling – Spring 2010:

- Surficial sediment samples (0-0.5 ft depth increment beneath the water/sediment interface) co-located with the surface water samples collected at either midstream (for the river reaches) or at greater than 200 ft from the shoreline (for the lake stations);
- Surficial sediment nearshore (shore) samples (0-0.5 ft depth increment beneath the water/sediment interface) collected 2-10 ft below the waterline;
- Surface water collected prior to sediment collection or disturbance at each site;
- Surface water collected following agitation of sediment upstream from each sampling point; and
- Beach soils collected approximately 6-10 ft above the waterline.
- Additional sediment and water samples at five beach locations; two transects with five sediment samples and four water samples per transect at each location.

Detected arsenic concentrations in surface water samples were compared to the USEPA Drinking Water Criterion for arsenic of 10 parts per billion (ppb or µg/L), and the results for detected arsenic concentrations in sediment and soil were compared to the Site Clean-up Level of 20 parts per million (ppm or mg/Kg) for arsenic in solids. The Site Clean-up Level of 20 ppm is based upon the New Jersey Residential Clean-up Standard for Arsenic. The surface water, soil, and sediment results for each station (excluding the additional beach sediment samples) from the Periodic Sampling – Spring 2010 were also compared to the May 2006 Baseline Sampling results (EA 2006a), November 2006 Periodic Sampling results (EA 2007), September 2007 Post Remedial Action Sampling results (EA 2008), Periodic Sampling – Spring 2009 results (EA 2009), and Periodic Sampling – Fall 2009 results (EA 2010). Additionally, the surface water, soil, and sediment results from the Periodic Sampling – Spring 2010 beach stations were compared to historical arsenic data collected from five beach stations during the year 1992 and from 1994 through 1999.

ES.1 ARSENIC RESULTS

Figure ES-2 presents arsenic concentrations for each of the six sampling events: the May 2006 Baseline Sampling, the November 2006 Periodic Sampling, the September 2007 Post Remedial Action Sampling, the Periodic Sampling – Spring 2009, the Periodic Sampling – Fall 2009, and the Periodic Sampling – Spring 2010.

Overall, results of the Periodic Sampling – Spring 2010 indicated that arsenic concentrations in agitated water samples exceeded the 10 µg/L criterion at four of the eight sampling locations. The last sampling event, Periodic Sampling – Fall 2009, had exceedences in agitated water samples at three of nine locations. The highest concentration of arsenic in an agitated water sample for Spring 2010 was at Station 6 (“Bare A” Beach) with a value of 370 µg/L.

In the previous May 2006 and November 2006 Sampling events, the two stations located immediately downstream of the Vineland site, Station 1 (West of Mill Rd.) and Station 2 (West of Rte. 55) had the highest concentrations of arsenic in sediment and had the greatest number of concentrations that exceeded the Site Clean-up Level of 20 mg/kg for arsenic (Figure 3-1).

Station 1 (West of Mill Road) was not sampled during the Periodic Sampling – Spring 2009, Fall 2009, and Spring 2010 events due to excavation and remediation at that location by the United States Corps of Engineers-Philadelphia District (USACE-Philadelphia). The Blackwater Branch's stream flow was also diverted at this location to allow excavation activities to be completed. Station 2 (West of Route 55), located immediately downstream of the Vineland site, had the highest concentrations of arsenic in sediment for the Spring 2009 sampling and also had the greatest number of concentrations exceeding the Site Clean-up Level of 20 ppm for arsenic (Figure 3-1). Station 2 was not sampled during Periodic Sampling – Fall 2009 and Spring 2010 due to excavation and remediation at the site; the Blackwater Branch was also diverted at this location.

Two stations located downstream from Station 2 and upstream of Union Lake had arsenic concentrations in sediments and soils that exceeded the Site Clean-up Level of 20 mg/kg. Station 3 (Blackwater Branch confluence) had a concentration of 150 mg/Kg in the shore sediment and Station 6 ("BareA" Beach) had a concentration of 160 mg/Kg in the shore sediment and 120 mg/Kg in the in-stream sediment sample.

Two stations located along Union Lake had arsenic concentrations in sediments that exceeded the Site Clean-up Level of 20 ppm. The shore sample at Station 8 (North End of Union Lake) had an arsenic concentration of 110 mg/Kg and an arsenic concentration of 410 mg/Kg in the sediment sample. The sediment sample offshore from Union Lake Beach had arsenic detected at a concentration of 330 mg/Kg. These trends in Union Lake may be attributable to the proportion of fine silt/clays in the sediment samples; arsenic is strongly sorbed onto fine particulates, including silt (Bodek et. al 1988). The arsenic that originates from upstream sources may be transported downstream via particulates which settle out in the lake depositional areas. Previous reports for the site have stated that sediment in the Maurice River and Union Lake contains a high content of organic matter (USEPA 1999). Arsenic concentrations from the five beach locations [Station 4 (Alliance Beach), Station 5 (Almond Beach), Station 6 ("BareA" Beach), Station 9 (Union Lake Beach), and Station 10 (South End Union Lake Beach)] were either $\leq$ 1.1 mg/Kg or below the analytical detection limit.

Below Station 2 (West of Rte. 55), additional water flow from the Maurice River and other tributaries flowing into the Maurice River may transport arsenic that is bound to fine particulates further downstream. Previously in the May 2006 and November 2006 sampling events, arsenic concentrations in sediments, surface water, and beach soil did not exceed criteria at Station 4 (Alliance Beach), Station 5 (Almond Beach), or Station 6 ("BareA" Beach). In September 2007, the first exceedence of applicable criteria occurred at Station 5 (Almond Beach) in the agitated water sample and at Station 6 ("BareA" Beach) in both a surface water sample and a nearshore (shore) sediment sample. During sampling in May 2009 the only samples to exceed the Site Clean-up Levels were the agitated water sample (Wat2) and the shore (sediment) samples at Station 6; the arsenic concentrations were 65 ug/L and 21 mg/kg, respectively. Periodic Sampling – Fall 2009 had criteria exceedences of agitated water at Station 7 (Sherman Avenue) and shore samples at Station 3 (Blackwater Branch confluence) and Station 6 ("BareA" Beach). The Periodic Sampling – Spring 2010 had an exceedance of 10 ppb for the agitated water sample at Station 6; shore and sediment samples at Station 6 exceeded the Site Clean-up Level of

20 ppm. Stations 4 and 5 did not exceed criterion for surface water, sediment, or beach samples in Spring 2010.

Arsenic results for each sampling location and matrix (sediment, water, beach soil) are presented in Figure ES-2 and summarized as follows:

Station 1 – West of Mill Rd (see Figure 3-1)
Station 1 was not sampled during the Spring 2010 effort due to excavation and remedial activities currently being conducted by USACE-Philadelphia.

Station 2 – West of Rte 55 (see Figure 3-1)
Station 2 was not sampled during the Spring 2010 effort due to excavation and remedial activities currently being conducted by USACE-Philadelphia.

Station 3 – BWB & Maurice Confluence (see Figures 3-1 and 3-2)
Arsenic was detected above the USEPA Drinking Water Criterion of 10 ppb in the agitated water sample at a concentration of 58 µg/L. The shore sediment sample was detected at a concentration of 150 mg/Kg, 7.5 times above the Site Clean-up Level of 20 ppm. Arsenic was detected in the surficial mid-stream sediment sample at 3.1 mg/Kg.

Station 4 – Alliance Beach (see Figures 3-1,3-2, and 3-8)
Arsenic was detected in the surficial mid-stream sediment sample at 2.0 mg/Kg and in the shore sediment sample at 0.84 mg/Kg. Arsenic was not detected in the non-agitated or agitated water samples. In the additional beach transects, none of the arsenic concentrations exceeded the Site Clean-up Level. Two of the agitated water samples exceeded the USEPA Drinking Water Criterion.

Station 5 – Almond Beach (see Figures 3-1, 3-3, and 3-9)
Arsenic was not detected in the surface water, shore, or beach samples. Arsenic was detected in the surficial mid-stream sediment sample at 1.2 mg/Kg. In the additional beach transects, arsenic was not detected in the surface water samples; arsenic detected in the sediment samples was below the Site Clean-up Level of 20 ppm.

Station 6 – "BareA" Beach (see Figures 3-1, 3-4, and 3-10)
Arsenic was detected in the non-agitated water sample (8.9 µg/L) and agitated water sample (370 µg/L); the agitated water sample exceeded the USEPA Drinking Water Criterion of 10 ppb by a factor of 37. The sediment sample exceeded the Site-Clean up Level of 20 ppm by a factor of 6 with an arsenic concentration of 120 mg/Kg. The shore sample had an arsenic concentration of 160 mg/Kg exceeding the 20 ppm criterion by a factor of 8. Arsenic was not detected in the beach sample. The additional beach transect results had 8 of 10 sediment samples exceeding the Site Clean-up Level. Four agitated water samples at the additional beach transects exceeded the USEPA Drinking Water Criterion.

Station 7 – Sherman Ave. (see Figures 3-1 and 3-5)
Arsenic was not detected in the non-agitated or agitated surface water samples. Arsenic was detected in the sediment sample (3.8 mg/Kg) and shore sample (3.7 mg/Kg); both were below the Site Clean-up Level of 20 ppm.

Station 8 – North End of Union Lake (see Figures 3-1 and 3-6)
The agitated water sample exceeded the criterion of 10 ppb by a factor of 7.6 with an arsenic concentration of 76 µg/L. Arsenic was detected in both the sediment sample (410 mg/Kg) and shore sample (110 mg/Kg). The samples exceeded the Site Clean-up Level of 20 ppm by factors of 20.5 and 5.5, respectively.

Station 9 – Union Lake Beach (see Figures 3-1, 3-7, and 3-11)
The non-agitated surface water sample exceeded the criterion of 10 ppb by a factor of 1.4 with a concentration of 14 µg/L. The agitated water sample also exceeded the criterion of 10 ppb by a factor of 12 with an arsenic concentration of 120 µg/L. Arsenic was detected in the sediment sample at a concentration of 330 mg/Kg exceeding the 20 ppm criterion by a factor of 16.5. Arsenic was detected below the 20 ppm criterion in the shore sample with a concentration of 2.3 mg/kg and in the beach sample with a concentration of 1.1 mg/Kg. In additional beach transects, arsenic was detected in all of the sediment samples but at concentrations lower than the Site Clean-up Level of 10 ppm. One agitated water sample, ULBT2-WAT2, exceeded the criterion of 10 ppb by a factor of 1.1 with an arsenic concentration of 11 µg/L.

Station 10 – South End of Union Lake Beach (see Figures 3-1, 3-7 and 3-12)
Arsenic was detected in the agitated water sample at a concentration of 14 ug/L; this exceeded the Drinking Water Criteria by a factor of 1.4. The sediment sample had an arsenic concentration of 9.8 mg/Kg and in the shore sample at a concentration of 1 mg/Kg; both samples were below the Site Clean-up Level of 20 ppm. Arsenic was not detected in the beach sample at this location. In additional beach transects, arsenic detected in sediment samples was below the criterion of 20 ppm. One agitated water sample, SULT2-WAT4, exceeded the criterion of 10 ppb by a factor of 1.1 with an arsenic concentration of 11 µg/L.

ES.2 COMPARISONS TO HISTORICAL ARSENIC DATA

During 1992 and from 1994 through 1999, surface water, soil, and sediment samples were collected in the vicinity of and downstream of the Vineland site at beach stations for arsenic analyses (USEPA/ERTC 1999). Data were collected from five beach locations including Alliance Beach (Station 4), Almond Beach (Station 5), "BareA" Beach (Station 6), Union Lake Beach (Station 9), and South End Union Lake Beach (Station 10). These data were compared to the May 2006 Baseline Sampling, the November 2006 Periodic Sampling, the September 2007 Post Remedial Action Sampling, the Periodic Sampling – Spring 2009 (May 2009), the Periodic Sampling – Fall 2009 (November 2009), and the Periodic Sampling – Spring 2010 (April/May) for surface water, beach soils, and surficial sediment arsenic concentrations.

Surface Water Data
Throughout the period of 1992 and 1994-1999, arsenic concentrations in surface waters at Station 4 (Alliance Beach), Station 5 (Almond Beach), and Station 6 ("BareA" Beach) were

variable and substantially exceeded the current USEPA Drinking Water Criterion of 10 ppb. Arsenic concentrations in surface waters at Station 9 (Union Lake Beach) slightly declined from 1996 (above criterion) through 1999 (below criterion). The arsenic concentration in surface water at Station 10 (South End of Union Lake Beach) was above the criterion in both 1998 and 1999. Surface water data from samples collected in both May 2006 and November 2006 indicated that arsenic was not detected in the non-agitated surface waters at each of these five previously sampled locations (Stations 4, 5, 6, 9, and 10). At Station 10 (South End of Union Lake Beach) in May 2006, arsenic in the agitated water sample was equivalent to the USEPA Drinking Criterion. However, in September 2007, there were several exceedences of the arsenic criterion in surface water. The majority of these exceedences corresponded to agitated water samples. During the May 2009 sampling, only two agitated samples exceeded the arsenic criterion. The exceedences were found at Station 6 and Station 10. November 2009 sampling resulted in two agitated water samples that exceeded the arsenic criterion; Station 9 had an arsenic concentration of 1,100 µg/L and Station 10 had a concentration of 19 µg/L. Samples collected in April 2010 had four exceedances of the Drinking Water Criterion. One of the exceedances was at Station 9 in the non-agitated sample (14 µg/L). The remaining three exceedances were in agitated samples at Stations 6, 9, and 10. The November 2009 arsenic concentration of 1,100 µg/L in an agitated surface water sample at Station 9 was the highest concentration measured between 1992 and 2010.

Beach Soil Data

None of the beach soil samples collected in 1992, 1994 through 1999, and 2006 exceeded the Site Clean-up Level of 20 ppm for arsenic at Station 4 (Alliance Beach), Station 5 (Almond Beach), Station 6 ("BareA" Beach), Station 9 (Union Lake Beach), and Station 10 (South End of Union Lake Beach). Detected concentrations in May 2006, November 2006, September 2007, May 2009, November 2009, and April 2010 were either comparable to or lower than those previously reported for each of the five stations. None of the 2006, 2007, 2009, and 2010 samples exceeded the Site Clean-up Level of 20 ppm.

Surface Sediment Data

Throughout the period of 1992 and 1994-1999, arsenic concentrations were below the Site Clean-up Level of 20 ppm at each of the five stations, with the exception of Station 6 ("BareA" Beach) in 1998. Results from samples collected between May 2006 and November 2009 indicated that arsenic concentrations in surficial sediment (collected greater than 200 ft from the shoreline) at Station 9 (Union Lake Beach) and Station 10 (South End of Union Lake Beach) were substantially higher than concentrations previously reported in 1992 and 1994-1999. The data from May 2006 to May 2009 show a slight decrease in arsenic concentrations for each successive sampling event. Results from November 2009 indicate an increase in arsenic concentration at Station 9 and Station 10 compared to May 2009 results. Surface sediment collected in April 2010 showed an increase in arsenic concentrations at Station 6 ("Bare A" Beach) compared to November 2009 results. Arsenic concentrations in surficial sediment at Station 9 were equivalent to results in November 2009.

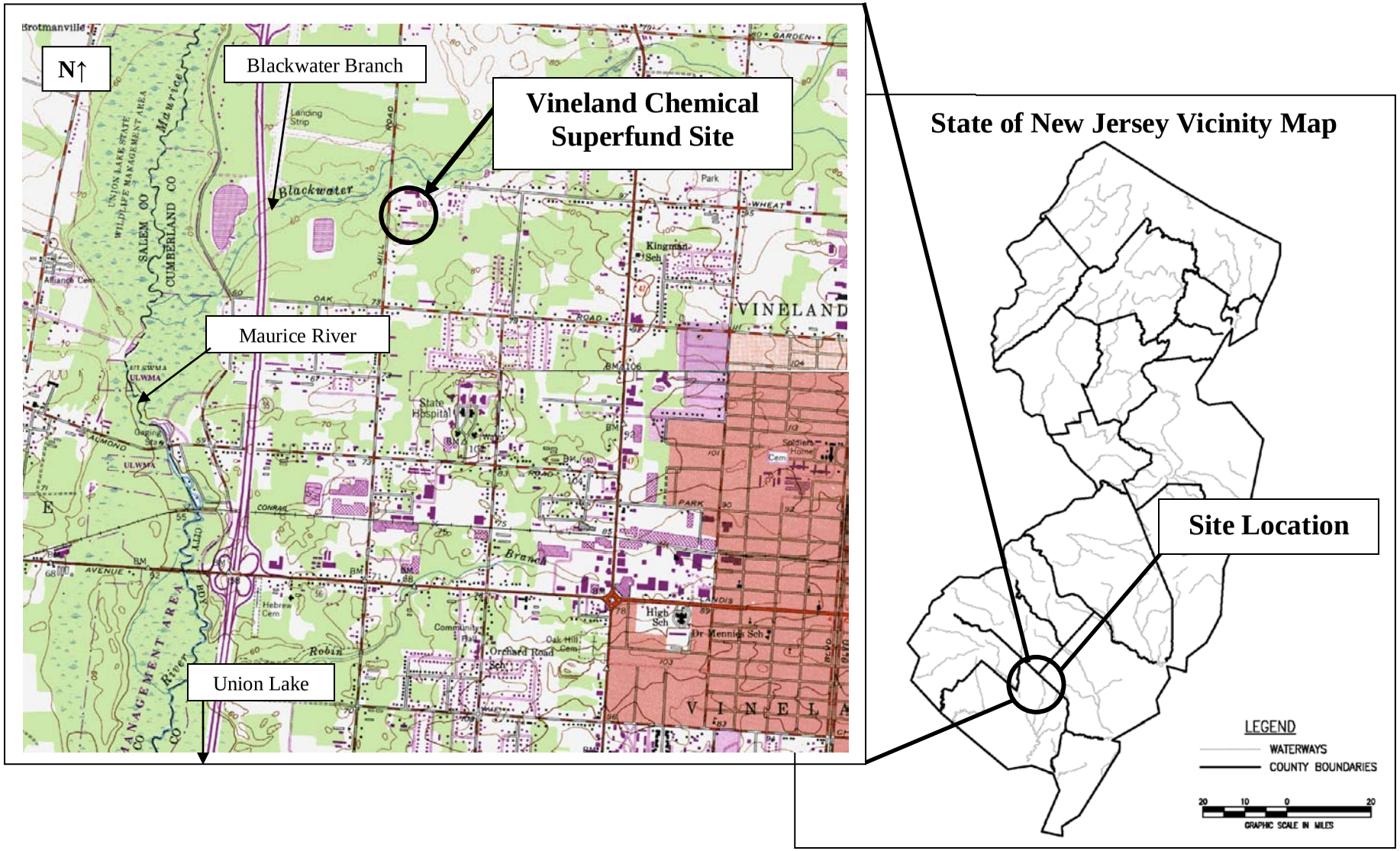


Figure ES-1. Vineland Chemical Superfund Site Location Map, Cumberland County, NJ

VINELAND CHEMICAL SUPERFUND SITE

N

1) West of Mill Rd

Sampling ID	Units	May 06 Results	Nov. 06 Results	Sept. 07 Results	May 09 Results	Nov. 09 Results	April 10 Results
MILL-SED (0-0.5 ft)	mg/Kg	14	160	8.2			
MILL-WAT1	ug/L	200	ND	ND			
MILL-WAT2	ug/L	ND	900	3,800			
MILL-BORING-1 (0-1 ft)	mg/Kg	120		94			
MILL-BORING-2 (1-2 ft)	mg/Kg	27		460			
MILL-BORING-3 (2-4 ft)	mg/Kg	4.7		6.1			
MILL-BORING-4 (4-5 ft)	mg/Kg	10					
MILL-SHORE	mg/Kg	270	140	130			

2) West of Rte 55

Sampling ID	Units	May 06 Results	Nov. 06 Results	Sept. 07 Results	May 09 Results	Nov. 09 Results	April 10 Results
R55-SED (0-0.5 ft)	mg/Kg	1,500	2,100	1,700	340		
R55-WAT1	ug/L	14	8.8	14	ND		
R55-WAT2	ug/L	1,900	660	700	12,000		
R55-BORING-1 (0-1 ft)	mg/Kg	160		1,900			
R55-BORING-2 (1-2 ft)	mg/Kg	82		3,600			
R55-BORING-3 (2-3 ft)	mg/Kg	30		9.7			
R55-SHORE	mg/Kg	1,200	4,500	3,400	2,100		

3) BWB & Maurice Confluence

Sampling ID	Units	May 06 Results	Nov. 06 Results	Sept. 07 Results	May 09 Results	Nov. 09 Results	April 10 Results
BWB-SED (0-0.5 ft)	mg/Kg	0.78	20	1.5	1.2	1.1	3.1
BWB-WAT1	ug/L	ND	ND	ND	ND	ND	ND
BWB-WAT2	ug/L	ND	ND	ND	ND	ND	58
BWB-SHORE	mg/Kg	ND	19	2	10	21	150

4) Alliance Beach

Sampling ID	Units	May 06 Results	Nov. 06 Results	Sept. 07 Results	May 09 Results	Nov. 09 Results	April 10 Results
ALLIANCE-SED (0-0.5 ft)	mg/Kg	1.9	1.3	ND	ND	0.79	2
ALLIANCE-WAT1	ug/L	ND	ND	ND	ND	ND	ND
ALLIANCE-WAT2	ug/L	ND	ND	ND	9.4	ND	ND
ALLIANCE-BORING-1 (0-1 ft)	mg/Kg	ND		ND			
ALLIANCE-BORING-2 (1-2 ft)	mg/Kg	ND					
ALLIANCE-BORING-3 (2-3.3 ft)	mg/Kg	ND					
ALLIANCE-BEACH	mg/Kg	1	ND	ND	1.2	ND	0.67
ALLIANCE-SHORE	mg/Kg	ND	1.5	ND	1.2	ND	0.84

5) Almond Beach

Sampling ID	Units	May 06 Results	Nov. 06 Results	Sept. 07 Results	May 09 Results	Nov. 09 Results	April 10 Results
ALMOND-SED (0-0.5 ft)	mg/Kg	2.5	1.4	1.3	1.5	0.94	1.2
ALMOND-WAT1	ug/L	ND	ND	ND	ND	ND	ND
ALMOND-WAT2	ug/L	ND	ND	16	ND	ND	ND
ALMOND-BORING-1 (0-1 ft)	mg/Kg	ND		2			
ALMOND-BORING-2 (1-2 ft)	mg/Kg	ND					
ALMOND-BORING-3 (2-2.4 ft)	mg/Kg	ND					
ALMOND-BEACH	mg/Kg	ND	ND	ND	ND	ND	ND
ALMOND-SHORE	mg/Kg	1	ND	ND	ND	ND	ND

6) "BareA" Beach

Sampling ID	Units	May 06 Results	Nov. 06 Results	Sept. 07 Results	May 09 Results	Nov. 09 Results	April 10 Results
BA-SED (0-0.5 ft)	mg/Kg	1.2	2.6	2.3	2.3	ND	120
BA-WAT1	ug/L	ND	ND	13	ND	ND	8.9
BA-WAT2	ug/L	ND	ND	ND	65	ND	370
BA-BEACH	mg/Kg	ND	ND	ND	ND	ND	ND
BA-SHORE	mg/Kg	1.3	4.5	290	21	280	160

7) Sherman Ave.

Sampling ID	Units	May 06 Results	Nov. 06 Results	Sept. 07 Results	May 09 Results	Nov. 09 Results	April 10 Results
SHERMAN-SED (0-0.5 ft)	mg/Kg	12	7.3	110	3.3	1.8	3.8
SHERMAN-WAT1	ug/L	ND	ND	12	ND	ND	ND
SHERMAN-WAT2	ug/L	55	11	100	ND	20	ND
SHERMAN-SHORE	mg/Kg	6.3	ND	5.5	2.7	1.5	3.7

8) North End of Union Lake

Sampling ID	Units	May 06 Results	Nov. 06 Results	Sept. 07 Results	May 09 Results	Nov. 09 Results	April 10 Results
NUL-SED (0-0.5 ft)	mg/Kg	230	510	30	190	14	410
NUL-WAT1	ug/L	ND	ND	ND	ND	ND	ND
NUL-WAT2	ug/L	ND	ND	22	ND	230	76
NUL-SHORE	mg/Kg	88	340	320	130	65	110

9) Union Lake Beach

Sampling ID	Units	May 06 Results	Nov. 06 Results	Sept. 07 Results	May 09 Results	Nov. 09 Results	April 10 Results
ULB-SED (0-0.5 ft)	mg/Kg	400	330	360	280	330	330
ULB-WAT1	ug/L	ND	ND	ND	ND	10	14
ULB-WAT2	ug/L	ND	ND	15	ND	1100	120
ULB-BORING-1 (0-1 ft)	mg/Kg	79		1.4			
ULB-BORING-2 (1-2 ft)	mg/Kg	31					
ULB-BEACH	mg/Kg	0.9	1.1	1	ND	0.91	1.1
ULB-SHORE	mg/Kg	2.4	8.1	2.1	1.7	5.2	2.3

10) South End Union Lake Beach

Sampling ID	Units	May 06 Results	Nov. 06 Results	Sept. 07 Results	May 09 Results	Nov. 09 Results	April 10 Results
SUL-SED (0-0.5 ft)	mg/Kg	160	10	18	28	40	9.8
SUL-WAT1	ug/L	ND	ND	ND	ND	9.2	ND
SUL-WAT2	ug/L	10	ND	28	550	19	14
SUL-BORING-1 (0-1 ft)	mg/Kg	390		12			
SUL-BORING-2 (1-2 ft)	mg/Kg	110					
SUL-BORING-3 (2-3.4 ft)	mg/Kg	1.7					
SUL-BEACH	mg/Kg	ND	ND	ND	ND	ND	0.53
SUL-SHORE	mg/Kg	1.4	2.1	6.5	2.3	1	1.2

KEY:

- **SED** — Surface sediment co-located with surface water sample; midstream or greater than 200 ft from shoreline for lake samples
- **WAT1** — Surface water sample
- **WAT2** — Water sample following agitation of sediment
- **BORING** — Sediment boring to specified depth interval
- **BEACH** — Beach soil collected 6-10 ft above waterline
- **SHORE** — Surface sediment collected within 2-10 ft below waterline

NOTES:

ND = Non-detect
Red values indicate arsenic exceedences as noted below:
Site Clean-up level for solids = 20ppm (mg/Kg)
USEPA Drinking water criterion for water = 10 ppb (ug/L)
= No sample collected

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

VINELAND CHEMICAL SUPERFUND SITE
VINELAND, NJ

ARSENIC CONCENTRATIONS: BASELINE AND PERIODIC SAMPLING (2006), POST REMEDIAL ACTION SAMPLING (2007), AND PERIODIC SAMPLING (2009, 2010)

PROJECT MGR.	DESIGNED BY	DRAWN BY	CHECKED BY	DATE	SCALE	PROJECT NO.	FILE NAME	DRAWING NO.	FIGURE
-	-	JAP	-	MAY 2010	1"=3,000'	62305.01	-	-	ES-2

FILE PATH: (LOVETON) Q:\PROJECTS\6202706\DWG\NOVEMBER UPDATES\UNION LAKE QUAD FIG 3-1 MAY 2010.DWG [LAYOUT1] 6/4/10

1. INTRODUCTION

This report presents results from an arsenic survey in the vicinity of Vineland Chemical Company Superfund Site in Cumberland County, New Jersey (NJ) that was conducted for 7 locations from 6 through 8 April 2010 and one location (Sherman Avenue) on 19 May 2010 in accordance with the *Uniform Federal Policy/Quality Assurance Project Plan (UFP/QAPP) for Vineland Chemical Superfund Site* (USACE 2009). Additional sediment samples were collected at the five beach locations during the April sampling period. Two transects were sampled at each beach location with five sediment samples collected at each transect for a total of 50 beach sediment samples. In addition, water samples were collected at the end points of each transect. These data will be used to document the arsenic concentrations in nearby waterways that have been impacted by previous operations of the site following the remediation activities. Results for soils and sediments will be compared to the Site Clean-up Level of 20 parts per million (ppm or mg/Kg) and results for surface water will be compared to the U.S. Environmental Protection Agency (USEPA) Drinking Water Criterion of 10 parts per billion (ppb or µg/L) for the protection of human health. These data (referred to as the Periodic Sampling – Spring 2010) represent the sixth sampling and monitoring event that was planned to assess the potential impacts of remedial activities at the site.

1.1 PROJECT BACKGROUND

Previous studies have shown that the Vineland Chemical Company Superfund Site (site) has arsenic contamination in the soils, sediments, and ground water. The site manufactured arsenic-based herbicides from 1950 to 1994 on a 54-acre site in a residential and industrial area of the City of Vineland, NJ. The site is located adjacent and upstream from nearby waterways that include the Blackwater Branch, Maurice River, and Union Lake (Figure 1-1). The soil, sediment, and water of these waterbodies have been impacted by the operations of the site. Beginning in 1982, and in response to State actions, the Vineland Chemical Company instituted some cleanup actions and modified the production process. The site clean-up is being addressed in two stages, including immediate actions and long-term remedial phases. Four long-term, remedial phases will focus on source control, migration management, and cleanup of the rivers and Union Lake sediments, which was the subject of a Record of Decision (ROD) in 1989 (USEPA 1989). The current phase of remediation at the site involves removing the contaminated soils/sediments of the Blackwater Branch and the floodplain west of Mill Road to west of the Maurice River Parkway. This excavation has the potential to stir up sediments and impact the waterways downstream. Therefore, baseline (pre-excavation), during excavation, and post-remedial action sampling/monitoring is required.

Two general areas of consideration for the study include public health and remedial actions. The monitoring and sampling program is being completed to determine the status of exposure and impacts to human health exposure pathways. Results from sampling efforts will determine the extent of contamination in the surrounding areas prior to excavation activities, during excavation, and post-excavation. The first survey, the May 2006 Baseline Sampling (EA 2006a), was conducted prior to the initiation of planned remedial excavation activities in the Blackwater Branch. The second survey, the November 2006 Periodic Sampling (EA 2007), was conducted

during excavation activities at the site. The third survey, the September 2007 Post Remedial Action Sampling, was conducted following the completion of excavation for remedial action activities east of Mill Road and adjacent to the site. The fourth survey, the Periodic Sampling – Spring 2009, was conducted during excavation for remedial action activities west of Mill Road to Route 55. The fifth survey, the Periodic Sampling – Fall 2009, and sixth survey, the Periodic Sampling – Spring 2010, were conducted during excavation for remedial action activities west of Mill Road to west of the Maurice River Parkway.

A three year period of monitoring and sampling will be implemented at the completion of Operational Unit #1 remediation activities. This will determine the impacts of remedial activities including removal of contaminated soil and sediments and pump and treat groundwater program to facilitate evaluation of further remedial action in the river areas and Union Lake.

1.2 PROJECT LOCATION

The Vineland Chemical site is a 54-acre manufacturing facility located in Vineland, Cumberland County, NJ (Figure 1-1). The site is located in south-central NJ, approximately 40 miles from Wilmington, Delaware and approximately 35 miles from Atlantic City, NJ. The facility was involved in the production of arsenical herbicides, fungicides, and biocides since 1949. Arsenical feedstock compounds were historically stored in unprotected piles. This resulted in soil and groundwater contamination in the vicinity of the site. Runoff during storm events and the recharge of arsenic-bearing groundwater has contaminated the adjacent watershed, including nearby waterways such as Blackwater Branch, Maurice River, and Union Lake.

1.3 PROJECT PURPOSE AND OBJECTIVES

Determination of arsenic concentrations in the sediments, soil, and surface water in the vicinity of the site is necessary in order to provide information about the environmental conditions at the site during and following the Blackwater Branch excavation activities to assess potential human exposure to arsenic and to document the extent of contamination. This sampling and monitoring effort, the Periodic Sampling – Spring 2010, documents the levels of arsenic concentrations in the sediment, soil, and surface water during the excavation process, and compares current (April and May 2010) arsenic concentrations to the May 2006 Baseline Sampling (EA 2006a), the November 2006 Periodic Sampling (EA 2007), the September 2007 Post Remedial Action Sampling (EA 2008), the Periodic Sampling – Spring 2009 (EA 2009), the Periodic Sampling – Fall 2009 (EA 2010), and the historic (1992 and 1994 through 1999) arsenic concentrations at the site. Additional sediment collected at the beach locations will be analyzed independently of the previous sampling efforts.

The Periodic Sampling – Spring 2010 program consisted of the following tasks:

- Sediment, soil, and surface water sample collection at 8 locations;
- Sediment sample collection at 5 beach locations with 2 transects per beach location consisting of 5 sediment samples per transect;

- Surface water sample collection at the endpoints of each additional beach transect;
- Analytical testing of sediment, soil, and surface water samples for arsenic concentrations;
- Data report preparation and submittal.

1.4 EXPERIMENTAL DESIGN

The executing agency for this project is the U.S. Army Corps of Engineers (USACE), North Atlantic Division, Philadelphia District. This investigation was designed to identify, analyze, and evaluate the arsenic concentrations in sediments, soil, and surface water collected at ten locations in and near waterways located adjacent to the site. Previous sampling activities documented arsenic concentrations at 10 locations, but two locations that were previously sampled (West of Mill Road and West of Route 55) were not sampled in the Spring 2010 because the stream areas where these stations were previously located were realigned/re-routed as part of the ongoing remedial activity. EA Engineering, Science, and Technology, Inc. (EA) was contracted by the USACE - Philadelphia District to conduct sediment, soil, and surface water sampling at eight locations along Blackwater Branch, the Maurice River, and Union Lake. Arsenic concentrations in each of the samples were measured by the USEPA Region II Laboratory located in Edison, NJ. The *Uniform Federal Policy/Quality Assurance Project Plan (UFP/QAPP)* (USACE 2009) described the sampling and data-gathering methods for the project and followed guidance provided by the USACE Engineer Manual (EM) 200-1-3 *Requirements for Preparation of Sampling and Analysis Plans* (2001).

1.5 REPORT ORGANIZATION

This report contains a comprehensive summary of field activities and the results of the sediment, soil and surface water analyses. Field sampling techniques and analytical methodologies for arsenic analyses are provided in Chapter 2 and results of the arsenic analyses are provided in Chapter 3. A summary of findings and a comparison to historical data is provided in Chapter 4. References cited are provided in Chapter 5. Appendix A presents the analytical results and accompanying Chain-of-Custody (COC) forms from the arsenic analyses; Appendix B provides a copy of the field logbook; and Appendix C presents the historical arsenic data results from the years 1992 and from 1994 through 1999.

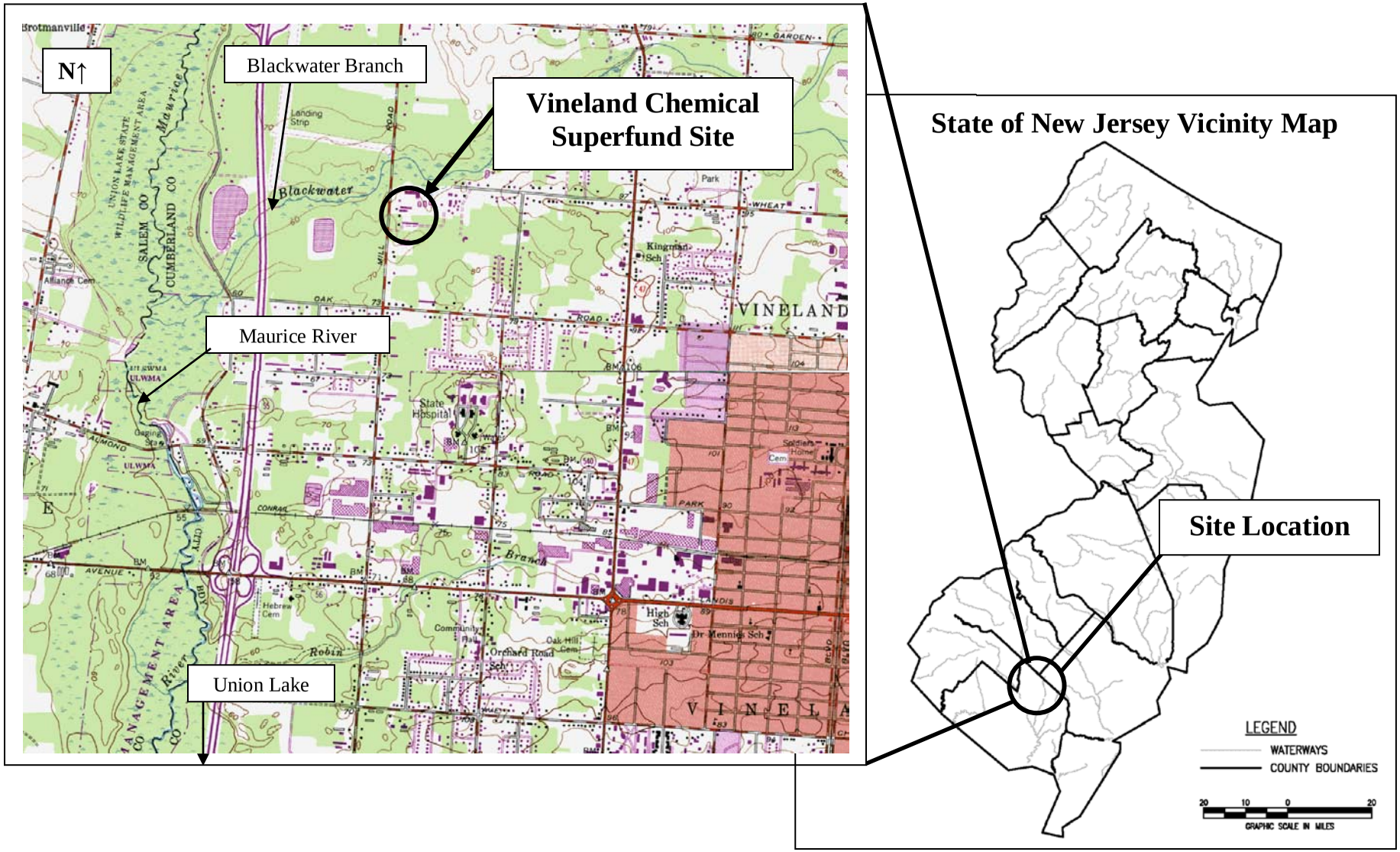


Figure 1-1. Vineland Chemical Superfund Site Location Map, Cumberland County, NJ

2. METHODOLOGY

This Periodic Sampling – Spring 2010 event was carried out in accordance with the *Uniform Federal Policy/Quality Assurance Project Plan (UFP/QAPP)* (USACE 2009). Collection of the surface water, soil, and sediment quality samples was completed on 6, 7, and 8 April 2010; due to high spring river flow, sampling at Sherman Avenue (Station 7) was not completed until 19 May 2010.

Table 2-1 summarizes the sampling requirements for the Periodic Sampling – Spring 2010. Two surface water samples (the first representing a non-agitated surface water sample and the second representing an agitated surface water sample) were collected from each of eight stations (16 total surface water samples). In addition, one surficial sediment sample was collected from mid-stream (or 200 ft from offshore at lake locations) at each of eight stations, one nearshore (shore) sediment sample was collected from each of eight stations, and one beach soil sample was collected from each of five stations. Each sediment, soil, and surface water sample (non-agitated and agitated) was analyzed for total arsenic concentrations. Previous sampling efforts included sediment, soil, and surface water samples at two locations: West of Mill Road and West of Route 55. Due to remediation activities at these locations, the Blackwater Branch was re-aligned and sediment and soil material was excavated. No samples were taken at these locations for the Spring 2010 sampling effort.

Table 2-5 summarizes the sampling requirements for ten additional beach transects that were collected concurrently with Periodic Sampling – Spring 2010. Two transects were established at each of the five beach locations. Sediment samples were collected at five locations along each transect and surface water samples (non-agitated and agitated) were collected at the endpoints of each transect.

2.1 SAMPLING OBJECTIVES

The Periodic Sampling – Spring 2010 effort included surficial sediment sampling, non-agitated and agitated surface water sampling, nearshore (shore) sediment sampling, and beach soil sampling. Table 2-1 provides the sampling locations and number of samples collected as part of the Spring 2010 sampling event for the project. Table 2-2 provides the sampling locations, coordinates of the sampling efforts, and sample identification. The overall objectives of the field sampling were to:

- Collect two surface water samples (non-agitated and agitated) of the water column (mid-stream and mid-depth) at each of 8 locations for arsenic analysis;

- Collect one shallow sediment sample (0-0.5 ft depth increment beneath the surface water/sediment interface) at 8 locations at either mid-stream (for upper sampling locations approx. 2-3 ft from shoreline) or greater than 200 ft from the shoreline (lake sampling locations) for arsenic analysis;

- Collect one shallow, nearshore (shore) sediment sample (0-0.5 ft depth increment beneath the surface water/sediment interface) at 8 locations approximately 2-10 ft below the waterline for arsenic analysis;

- Collect one beach soil sample at five locations approximately 6-10 ft above waterline for arsenic analysis;

- Collect and transfer sediment, soil, and surface water samples to appropriate, laboratory-prepared containers and preserve/hold samples for analysis according to protocols that ensure sample integrity;

- Measure and record *in situ* water quality information (temperature, conductivity, salinity, dissolved oxygen, and pH) at each surface water sampling location;

- Submit equipment blanks, duplicates, and matrix spike/matrix spike duplicates for analytical testing; and

- Complete appropriate COC documentation.

The additional beach transect sampling consisted of the following :

- Conduct sediment sampling at two transects per beach location for a total of 10 transects ;

- Collect five shallow sediment samples (0-0.5 ft depth increment beneath the surface water/sediment interface) at each transect.

- Collect 2 surface water samples (non-agitated and agitated).

- Collect and transfer sediment, soil, and surface water samples to appropriate, laboratory-prepared containers and preserve/hold samples for analysis according to protocols that ensure sample integrity;

- Submit equipment blanks, duplicates, and matrix spike/matrix spike duplicates for analytical testing; and

- Complete appropriate COC documentation.

2.2 SAMPLING LOCATION DETERMINATION

Sampling locations for Periodic Sampling – Spring 2010 were provided by USACE-Philadelphia District and correspond to locations that were sampled in previous investigations (USEPA/ERTC 1999, EA 2006a, EA 2007, EA 2008). Sampling locations and northing and easting coordinates [NJ State Plane North American Datum 1983 (NAD83)] are provided in Table 2-2. Positioning in the field was determined using a Trimble ProXR Differential Global Positioning System

(DGPS), which utilizes the United States Coast Guard Differential Beacon System to obtain sub-meter accuracy. Sample locations and a brief description are included below:

Sample Location:	**Description of Sampling Location:**
1) West of Mill Rd	Along Blackwater Branch, immediately downstream of site; not sampled for Fall 2009 due to realignment of Blackwater Branch and excavation of soil and sediment.
2) West of Rte 55	Along Blackwater Branch, further downstream of site; not sampled for Fall 2009 due to realignment of Blackwater Branch and excavation of soil and sediment.
3) BWB & Maurice Confluence	At the Blackwater Branch and Maurice River confluence
4) Alliance Beach	Privately owned and located along the Maurice River and upstream of Almond Beach
5) Almond Beach	Along the Maurice River, publicly maintained beach area, approximately 100-150 ft long
6) "BareA" Beach	Along the Maurice River, downstream of Almond Beach, unmaintained public day-use area
7) Sherman Ave.	Along the Maurice River, at the Sherman Avenue Bridge
8) North End of Union Lake	In the northern section of Union Lake
9) Union Lake Beach	Privately maintained beach area, downstream of site (access at Union Lake Sailing and Tennis Club)
10) South End Union Lake Beach	In the southern section of Union Lake, north of the spillway

Sampling locations for the additional beach transects were determined in the field by EA personnel; sample spacing along the transects was dependent upon water depth at the time of sampling. Sample location coordinates, water depths, and sample distances offshore are provided in Table 3-3.

2.3 SAMPLE VOLUME REQUIREMENTS

The sample volume requirements are detailed in Table 2-1 for arsenic analyses. Arsenic analysis of sediments and beach soils required 250 grams of sediment per sample. Surface water samples required 250 milliliters (ml) per sample for arsenic analysis. For arsenic analyses, a total (not including field duplicates, matrix spike, and matrix spike duplicates) of eight sediment samples, eight shore samples, and five beach soil samples were collected for the Periodic Sampling – Spring 2010 effort. For arsenic analyses, 16 surface water samples (not including field duplicates, equipment blanks, matrix spike, and matrix spike duplicates) were collected. Fifty sediment samples and 40 surface water samples were collected for the additional beach transects (Table 2-5).

2.4 *IN SITU* WATER QUALITY MEASUREMENTS

Water quality measurements were recorded *in situ* at each of the eight stations using a YSI water quality probe. Measurements were recorded at the same locations where surface water samples were collected for chemical analysis (mid-stream/mid-depth of the water column). The following parameters were recorded in the field log book:

- Sampling location number
- Sampling data and time
- Station depth
- Weather conditions
- Water temperature [degrees (^{0}) Celsius]
- Conductivity (mS/cm)
- pH
- Dissolved oxygen [milligrams per liter (mg/L)]

A summary of the water quality data is provided in Table 2-3. Copies of the field logbook are provided in Appendix B.

2.5 SAMPLE COLLECTION, STORAGE, AND TRANSPORT

During sample collection samples were kept on ice in insulated coolers. Upon completion of sample collection, samples were shipped via overnight delivery to the USEPA Region II, Division of Environmental Science and Assessment (DESA) Laboratory in Edison, NJ for arsenic analyses. Samples were shipped on ice and maintained at 4^0 Celsius. COCs accompanied the samples and documented the dates and times of sample collections for arsenic analyses are included in Appendix A. Samples were received at the DESA laboratory on 9 April and 19 May 2010 (Sherman Avenue samples) for arsenic analyses and the samples were booked and logged through the Field and Analytical Services Teaming Advisory Committee (FASTAC) process.

2.5.1 Surface Water Samples

For the Periodic Sampling – Spring 2010 surface water samples were collected from eight locations along Blackwater Branch, the Maurice River and Union Lake for arsenic analysis. At each location, one surface water sample was collected as a mid-stream, mid-water column sample prior to any disturbance of bottom sediment (non-agitated). The second surface water sample was collected at the same location as above after disturbance of the bottom sediment (agitated). This agitated surface water sample was used to simulate potential human exposure to arsenic contaminated surface water with suspended sediment during recreational contact (i.e., beach use, wading, and swimming).

For the additional beach transect sampling, surface water samples were collected at each transect endpoint. The first location was the sampling point farthest offshore; the second location was the

sampling point at the edge of the water near shore. Two surface water samples (non-agitated and agitated) were collected at each point.

The agitated surface water sample was conducted by wading in the water in a region 0-10 ft upstream of the sampling location for approximately 30 seconds. The "disturbed" surface water sample was collected from mid-depth of the water column immediately following the disturbance of the bottom sediments.

Surface water samples were collected using an ISCO peristaltic pump with dedicated Tygon tubing. Surface water samples were transferred directly to pre-cleaned 250 ml plastic bottles preserved with nitric acid. Samples were kept on ice and maintained at 4^0 Celsius.

2.5.2 Shallow Sediment Samples

Two types of shallow sediment samples were collected for the Periodic Sampling – Spring 2010 effort, including in-stream and nearshore (shore) sediment samples for arsenic analysis. Shallow sediment samples were also collected at 50 locations for the additional beach transect sampling. The shallow sediment samples were collected using a decontaminated stainless-steel Ponar grab sampler. Samples were homogenized in the field using stainless steel bowls and spoons immediately following sample collection. The homogenized sediment samples were then transferred directly to 4 ounce glass jars; samples were kept on ice and maintained at 4^0 Celsius. The stainless steel bowls and spoons were decontaminated following the process described in Section 2.6.

2.5.2.1 In-Stream Sediment Samples

In-stream sediment samples were collected from eight locations along Blackwater Branch, the Maurice River and Union Lake. Sediment samples were co-located with surface water samples. The shallow sediment samples were collected from the 0-0.5 ft depth increment beneath the surface water/sediment interface. These samples were collected at either midstream (river locations) or at a distance of greater than 200 ft from the shoreline (lake locations).

2.5.2.2 Nearshore (Shore) Sediment Samples

Nearshore (shore) sediment samples were collected from eight locations along Blackwater Branch, the Maurice River and Union Lake 2-10 ft feet below the waterline. Similar to the shallow sediment sample collection, the shore sediment sample was collected from the 0-0.5 ft depth increment beneath the surface water/sediment interface and used to simulate potential human exposure to arsenic contaminated sediment during recreational activities/recreational contact (i.e., beach wading, playing in shallow near shore water, a special concern regarding children).

2.5.3 Beach Soils

Beach soils were sampled from five locations along the Maurice River and Union Lake for arsenic analysis. Figure 2-1 provides the location of the beach sampling points. Sampling points

were located at Station 4 (Alliance Beach), Station 5 (Almond Beach), Station 6 ("BareA" Beach), Station 9 (Union Lake Beach), and Station 10 (South End Union Lake Beach).

Samples were collected at the closest shore area adjacent to sediment sampling locations and approximately 6-10 ft above the waterline using a stainless steel spoon/shovel. A grab surface soil sample from a depth of 0-0.5 ft was collected and transferred to a stainless steel bowl and homogenized with a stainless steel spoon. The homogenized sediment samples were then transferred directly to a 4 ounce glass jar; samples were kept on ice and maintained at 4^0 Celsius. The stainless steel shovel, bowls, and spoons were decontaminated following the process described in Section 2.6.

2.5.4 Additional Beach Transect Sediment Samples

Sediment samples were collected along 2 transects at each beach location (Alliance, Almond, Bare "A", Union Lake Beach, and South End of Union Lake Beach) for a total of 10 transects. The shallow sediment samples were collected from the 0-0.5 ft depth increment beneath the surface water/sediment interface using a stainless-steel Ponar grab sampler. Five sediment samples were collected along each transect; samples were spaced evenly along each transect. The transect lengths varied at each beach according to water depths. A total of 50 sediment samples were collected for the additional beach transect sampling effort.

Section 2.5.1 details collection of non-agitated and agitated surface water samples at the additional beach transects. A total of 40 surface water samples were collected (20 non-agitated and 20 agitated surface water samples).

2.5.5 Equipment Blanks

Equipment blanks were collected to determine the extent of contamination, if any, from the sampling equipment used as part of the project. A total of four equipment blanks (Tables 2-1 and 2-4) were collected for the Periodic Sampling – Spring 2010 event, which included the following:

- One blank per sampling day (three samples collected) for shallow sediment sampling/beach sampling equipment (i.e., grab sampler) and,
- One blank per sampling event/phase (one sample collected) for dedicated surface water collection equipment (i.e., water pump tubing).

Equipment blanks were collected by pouring deionized water, which is provided by EA's Ecotoxicology Laboratory, over sampling equipment that was decontaminated using the procedure outlined in Section 2.6. The rinsate water was placed in laboratory-prepared containers, submitted to the analytical laboratory, and tested for the same chemical parameters as the sediments and site water. Equipment blanks were sent with the surface water, sediment, and beach soil samples to the USEPA Region II DESA laboratory for arsenic analyses.

2.5.6 Field Duplicates

Field duplicate samples were collected simultaneously from the same sampling locations as sediment and surface water samples and are used as measures of matrix homogeneity and sampling precision (Table 2-4 for Periodic Sampling – Spring 2010 and Table 2-5 for additional beach transects). Field duplicates were collected at a rate of 10% per sample matrix. For the Periodic Sampling a total of five duplicate samples were collected as individual co-located samples and were homogenized separately. Three field duplicate samples were collected at random locations for sediment and two field duplicate samples were collected at random locations for surface water. For the additional beach transects, four duplicate surface water samples and five duplicate sediment samples were collected.

2.5.7 Matrix Spike / Matrix Spike Duplicate Samples

A matrix spike (MS) is a field sample to which a known amount of analyte is added before sample preparation and analysis to evaluate the potential effects of matrix interference. Analyte concentrations in the spiked and unspiked sample are used to calculate percent recovery as a measure of matrix interference. A matrix spike duplicate (MSD) is a duplicate of the MS sample. MS/MSD samples were collected at a rate of 10% per sample matrix. Additional volumes of sediment and surface water were collected for the Periodic Sampling – Spring 2010 at random locations and included three sets of MS/MSD for sediment and soil samples and one set of MS/MSD for surface water samples (Tables 2-1 and 2-4). The additional beach transects included four sets of MS/MSD for surface water samples and five sets of MS/MSD for sediment samples (Table 2-6).

2.6 EQUIPMENT DECONTAMINATION PROCEDURES

Equipment that came into direct contact with sediment and beach soil during sampling was decontaminated prior to deployment in the field to minimize cross-contamination. This included the stainless-steel Ponar, stainless steel spoons, and processing equipment (spoons, knives, bowls, extruder, etc.). While performing the decontamination procedure, phthalate-free nitrile gloves were used to prevent phthalate contamination of the sampling equipment or the samples.

The decontamination procedure is described below:

- Rinse equipment using site water
- Rinse with distilled or de-ionized water
- Rinse with 1 percent nitric acid (HNO_3)
- Rinse with distilled or de-ionized water

Waste liquids were contained during decontamination procedures and transferred to EA's facility in Sparks, Maryland, for disposal.

2.7 SAMPLE CHAIN-OF-CUSTODY AND DOCUMENTATION

2.7.1 Field Logbook

Field notes were recorded in a permanently bound, dedicated field logbook. A log of sampling activities and station locations were recorded in the log in indelible ink. Personnel names, local weather conditions, and other applicable field sampling program information were also recorded.

Sample location coordinates, approximate water depth, and weather conditions at each sampling location were recorded. In addition, water quality was measured and recorded at each station using an electronic water quality monitoring instrument. Information was recorded in indelible ink. Copies of the project logbook are provided in Appendix B.

2.7.2 Sample Identification

A sample numbering system was utilized for the sediment, soil, and surface water samples for Periodic Sampling – Spring 2010. The sample numbering system provided communication between the sample processing operation and the laboratory performing the desired analyses. Surface water, shallow sediment, and beach soil samples were identified by site name, sample type, and date of collection. See table below for sample identification by locations:

Sample Location:	**Sample Identification:**
3) BWB & Maurice Confluence	BWB-
4) Alliance Beach	Alliance-
5) Almond Beach	Almond-
6) "BareA" Beach	BA-
7) Sherman Ave.	Sherman-
8) North End of Union Lake	NUL-
9) Union Lake Beach	ULB-
10) South End Union Lake Beach	SUL-

The following sample descriptors were then used to denote sample types:

- Shore – shallow sediment collected within 2-10 ft below the waterline;
- Sed – shallow sediment co-located with the surface water sample;
- Wat1 – surface water sample collected prior to sediment and/or core collection;
- Wat2 – surface water sample collected after sediment and/or core collection (following agitation and disturbance of the sediments);
- Beach – beach soil collected at the closest area adjacent to sediment sampling locations (approximately 6-10 ft above the waterline).

For example, sample BWB-Shore-*date* (MMDDYY) indicated a shallow sediment sample collected within 2 feet of the shoreline at the station located at the confluence of the Blackwater Branch and Maurice River. Each sample name was then followed with a date consisting of day,

month, and year of sample collection to enable differentiation between future sampling and monitoring events that will be scheduled at the site as part of the remediation activities.

The sample numbering system for the additional beach transects used the same sample location descriptor for each of the five beach areas. Two transects were sampled at each beach with five locations at each transect for sediment samples. Four surface water samples were collected per transect; two pre-agitated and two post-agitated samples were collected. One set of pre- and post-agitated samples was taken at the sampling location farthest offshore and one set of pre- and post-agitated samples was taken at the location closest to shore. Following is an example of the sample identification used for sediment samples:

SULT1-1

Where SUL denotes the beach location (South End of Union Lake), T1 denotes the first transect, and -1 denotes the sample farthest offshore. The sample taken closest to shore ended in -5. The second transect at the same beach was labeled with "T2" and followed the same numbering procedure.

For the additional beach transect pre- and post-agitated surface water samples, the sample descriptors used the same transect numbering scheme; the last digit was replaced with WAT1, WAT2, WAT3, or WAT4. Surface water samples ending in WAT1 and WAT2 were the samples taken farthest offshore and WAT1 was the pre-agitated sample and WAT2 was the post-agitated. Surface water samples ending in WAT3 and WAT4 were taken at the location on the transects closest to shore; WAT3 denoted pre-agitated surface water and WAT4 indicated post-agitated surface water.

Field Duplicate surface water and sediment samples were submitted to the laboratory as blind duplicates. The site name and collection date were not designated as part of the sample identifier. Duplicate samples were designated with an identifier (i.e., DUP) and number (i.e., 1, 2, 3, etc.). For example, DUP-1 was designated as the first duplicate sample collected from a random station. DUP-2 was then designated as the next (or second) duplicate sample collected from a separate random station. Locations where duplicate samples were collected and the corresponding sample ID were recorded in the field logbook for future cross-referencing with sample laboratory results. The cross-referenced sampling locations for the field duplicates are included in Table 2-4.

MS/MSD sediment, soil, and surface water samples were designated with identifiers added after the site name and sample type. For example, BA-Beach-MS-*date* indicated a matrix spike beach soil sample from the station located at "BA" Beach. The following descriptors were used for matrix spike and matrix spike duplicate samples:

- MS – matrix spike sample
- MSD – matrix spike duplicate

Equipment blanks were identified by type of blank, number of each type, and date (Table 2-4). For example, PBlank-02-date represented the second rinsate blank for the Ponar grab sampler

and bowls and spoons used for shallow sediment sampling. The following descriptors were used to denote equipment blanks:

- PBlank – Ponar grab sampler and bowls/spoons for shallow sediment samples
- TTBlank – dedicated tygon tubing blank for surface water sampling

2.7.3 Sample Documentation

2.7.3.1 Sample Labels

Both the individual sediment cores and the processed sediment were labeled. Sample containers for the processed sediment and surface water samples were labeled with the following information:

- Client name
- Project number
- Sample ID
- Station location
- Date and time of collection
- Sampler's initials
- Type of analyses required

2.7.3.2 Chain-of-Custody Records

Sediment, soil, and surface water samples collected in the field and at EA's processing facility were documented on a COC form. This COC accompanied the samples to the analytical and geotechnical laboratories. The COC indicated the date and time of sample collection and was signed by appropriate personnel. Copies of the COCs that accompanied the analytical testing for arsenic are provided in Appendix A.

2.7.4 Documentation Procedures

Documentation was initialed by the author and dated. Corrections to documentation were made with a single line through the error with the author's initials and date.

2.8 ANALYTICAL METHODS

Analytical testing for arsenic was conducted by the USEPA Region II DESA Laboratory Branch located in Edison, NJ.

2.8.1 Analytical Methods, Laboratory Quality Control, and Detection Limits

Samples obtained during the Periodic Sampling – Spring 2010 were analyzed for total arsenic using extraction procedure DESA SOP C-116 and analysis procedure DESA SOP C-109. Table 2-1 summarizes analytical information (total number of samples, QA/QC samples, sample volumes, sample holding times, and preservatives) for the project. The target detection limits

(TDL)/screening values and laboratory reporting limits (RL) for arsenic in the surface water and soils were as follows:

Matrix	Target Detection Limit (TDL) / Screening Value for Arsenic	Laboratory Reporting Limit (RL) for Arsenic	Extraction/Analysis Procedure
Water	10 ppb (USEPA Drinking Water Criterion)	8 µg/L (ppb)	DESA SOP C-116 and SOP C-109
Solid	20 ppm (Site Clean-up Level)*	0.73 to 0.8 mg/Kg (ppm)	DESA SOP C-116 and SOP C-109

**The Site Clean-up Level of 20 ppm is based upon the New Jersey Residential Clean-up Standard for Arsenic.*

Copies of the USEPA Region II DESA Laboratory Branch SOPs for sample digestion and for analysis of metals are provided in Appendix C, as well as laboratory Quality Control (QC) and Quality Assurance (QA) procedures.

2.8.2 Data Validation and Electronic Data Deliverables

Data validation was conducted by the USEPA Region II DESA laboratory for the arsenic analyses. A data quality and usability statement was not provided by DESA for the analytical results. Data are usable for the intended purpose except where noted by the USEPA data validation qualifiers.

Figure 2-1. Sampling Locations in Vicinity of Vineland Chemical Superfund Site, April/May 2010

TABLE 2-1. SUMMARY OF SEDIMENT, SOIL, AND WATER SAMPLES COLLECTED IN VICINITY OF VINELAND CHEMICAL SUPERFUND SITE, APRIL/MAY 2010

VINELAND PERIODIC SAMPLING - SPRING 2010

Sample Location (Name)	Sample Date	Type and Number of Samples			
		Sediment (sed)	Water (wat1/wat2)	Beach (beach)	Shore (shore)
		Arsenic	Arsenic	Arsenic	Arsenic
1) West of Mill Rd (MILL)	Not sampled	0	0	-	0
2) West of Rte 55 (R55)	Not sampled	0	0	-	0
3) BWB & Maurice Confluence (BWB)	4/7/2010	1	2	-	1
4) Alliance Beach (ALLIANCE)	4/7/2010	1	2	1	1
5) Almond Beach (ALMOND)	4/7/2010	1+DUP	2+DUP+MS, MSD	1+MS, MSD	1 + DUP
6) "BareA" Beach (BA)	4/7/2010	1	2+DUP	1 + MS, MSD	1
7) Sherman Ave. (SHERMAN)	5/19/2010	1	2	-	1
8) North End of Union Lake (NUL)	4/8/2010	1	2	-	1
9) Union Lake Beach (ULB)	4/6, 4/8/2010	1	2	1 + MS, MSD	1
10) South End Union Lake Beach (SUL)	4/6, 4/8/2010	1	2	1 + DUP	1
NUMBER OF SAMPLES	-	**8**	**16**	**5**	**8**
NUMBER OF QC SAMPLES	-	**1**	**4**	**7**	**1**
TOTAL NUMBER OF SAMPLES	-	**9**	**20**	**12**	**9**
Arsenic Samples:		**Sediment**	**Water**	**Beach**	**Shore**
Sample Volume		1 x 250 g	1 x 250 ml	1 x 250 g	1 x 250 g
Holding Time		6 months	6 months	6 months	6 months
Preservative/Temperature		$4^{o}C$	HNO_3 to pH <2, $4^{o}C$	$4^{o}C$	$4^{o}C$
Extraction/Analysis Methodologies		USEPA DESA SOP C-116/C-109	USEPA DESA SOP C-116/C-109	USEPA DESA SOP C-116/C-109	USEPA DESA SOP C-116/C-109

NOTE:

QC sample duplicates were collected and analyzed for each media at a rate of approximately 10% per sample matrix per analysis per sample event.

Sediment/soil equipment blanks= 1 blank each per day for beach soil and sediment

Aqueous equipment blank = 1 blank total for dedicated water pump/tubing

Blank Equipment Samples (5) Collected for Arsenic:

PBLANK-01, 02, 03: Bowls and spoons used for beach sampling

TTBLANK-01: Ponar grab sampler and bowls/spoons for shallow sediment samples

Dedicated tygon tubing blank for water sampling

TABLE 2-2. COORDINATES FOR WATER, SOIL, AND SEDIMENT SAMPLES COLLECTED IN VICINITY OF VINELAND CHEMICAL SUPERFUND SITE APRIL/MAY 2010

VINELAND PERIODIC SAMPLING - SPRING 2010

Sample Location	Sample Identification	Northing (ft)*	Easting (ft)*
1) West of Mill Rd	No sampling at location in April/May 2010 due to remedial activity.		
2) West of Rte 55	No sampling at location in April/May 2010 due to remedial activity.		
3) BWB & Maurice Confluence	BWB-SED	244849.1	329104.7
	BWB-WAT1, 2	244849.1	329104.7
	BWB-SHORE	244879.9	329129.9
4) Alliance Beach	ALLIANCE-SED	243399.9	328587.8
	ALLIANCE-WAT1, 2	243933.9	328587.8
	ALLIANCE-SHORE	243945.0	328576.0
	ALLIANCE-BEACH	243966.0	328540.6
5) Almond Beach	ALMOND-SED	241838.0	329512.0
	ALMOND-WAT1, 2	241838.0	329512.0
	ALMOND-SHORE	241835.6	329541.4
	ALMOND-BEACH	241844.9	329555.8
6) "BareA" Beach	BA-SED	238008.1	330366.5
	BA-WAT1, 2	238008.1	330366.5
	BA-SHORE	238004.7	330376.0
	BA-BEACH	238012.4	330401.9
7) Sherman Ave.	SHERMAN-SED	224398.4	330555.7
	SHERMAN-WAT1, 2	224398.4	330555.7
	SHERMAN-SHORE	224387.0	330561.7
8) North End of Union Lake	NUL-SED	219637.5	331304.8
	NUL-WAT1, 2	219637.5	331304.8
	NUL-SHORE	219649.1	331334.7
9) Union Lake Beach	ULB-SED	210487.8	335160.0
	ULB-WAT1, 2	210487.8	335160.0
	ULB-BEACH	210341.6	335388.5
	ULB-SHORE	210332.5	335336.4
10) South End Union Lake Beach	SUL-SED	208729.7	336396.6
	SUL-WAT1, 2	208729.7	336396.6
	SUL-SHORE	208754.9	336534.5
	SUL-BEACH	208760.3	336561.7

*Coordinates are in New Jersey State Plane (ft), NAD 83

TABLE 2-3. *IN SITU* WATER QUALITY MEASUREMENTS COLLECTED IN VICINITY OF VINELAND CHEMICAL SUPERFUND SITE: MAY 1999* THROUGH MAY 2010

VINELAND PERIODIC SAMPLING - SPRING 2010

Sample Location	Date and Time of Sample	Sample Depth	Water Temperature (degrees C)	Salinity (ppt)	Dissolved Oxygen (mg/L)	pH	Conductivity (mS/cm)
3) BWB & Maurice Confluence	4/7/2010 1600	Surface	21.2	0.05	9.9	6.3	0.111
4) Alliance Beach	4/7/2010 1632	Surface	21.1	0.05	10.3	6.2	0.111
5) Almond Beach	4/7/2010 1206	Surface	19.7	0.05	8.4	6.2	0.110
6) "BareA" Beach	4/7/2010 0917	Surface	18.8	0.05	6.2	6.2	0.110
7) Sherman Ave.	5/19/2010 1008	Surface	13.8	0.06	7.5	6.2	0.099
8) North End of Union Lake	4/8/2010 0941	Surface	19.4	0.06	6.3	6.5	0.133
9) Union Lake Beach	4/6/2010 1400	Surface	19.6	0.05	9.7	6.6	0.100
10) South End of Union Lake Beach	4/6/2010 1635	Surface	19.8	0.05	9.6	6.4	0.101
3) BWB & Maurice Confluence	11/18/09 1320	Surface	10.1	0.11	10.5	7.5	0.171
4) Alliance Beach	11/18/09 1401	Surface	10.3	0.12	10.7	7.5	0.175
5) Almond Beach	11/18/09 1515	Surface	10.4	0.11	10.6	7.1	0.171
6) "BareA" Beach	11/18/09 1613	Surface	10.5	0.11	10.8	7.0	0.170
7) Sherman Ave.	11/18/09 1702	Surface	11.2	0.13	10.6	7.2	0.197
8) North End of Union Lake	11/19/09 0834	Surface	11.1	0.12	10.3	7.6	0.190
9) Union Lake Beach	11/19/09 0918	Surface	11.1	0.12	10.9	7.5	0.179
10) South End of Union Lake Beach	11/19/09 0955	Surface	11.1	0.12	10.9	7.4	0.179
2) West of Rte 55	5/18/09 1110	Surface	14.9	0.07	13.4	6.0	0.117
3) BWB & Maurice Confluence	5/18/09 1335	Surface	16.1	0.06	12.8	6.4	0.097
4) Alliance Beach	5/18/09 1241	Surface	16.0	0.06	13.9	6.3	0.096
5) Almond Beach	5/18/09 1459	Surface	16.7	0.06	8.6	6.3	0.097
6) "BareA" Beach	5/18/09 1603	Surface	16.9	0.06	12.6	6.4	0.098
7) Sherman Ave.	5/18/09 1653	Surface	17.3	0.07	7.3	6.4	0.124
8) North End of Union Lake	5/19/09 0857	Surface	14.0	0.08	11.5	6.4	0.122
9) Union Lake Beach	5/19/09 0940	Surface	18.5	0.06	7.6	6.9	0.112
10) South End of Union Lake Beach	5/19/09 1017	Surface	18.7	0.06	7.0	6.8	0.112
1) West of Mill Rd	9/10/07 1730	Surface	22.3	0.06	8.9	7.6	0.121
2) West of Rte 55	9/11/07 0943	Surface	18.8	0.09	8.5	8.0	0.195
3) BWB & Maurice Confluence	9/11/07 1200	Surface	22.7	0.06	7.4	7.7	0.138
4) Alliance Beach	9/11/07 1404	Surface	22.9	0.07	7.3	7.5	0.140
5) Almond Beach	9/11/07 1538	Surface	22.8	0.07	7.4	7.2	0.140
6) "BareA" Beach	9/10/2007 1420	Surface	23.8	0.07	8.1	7.8	0.150
7) Sherman Ave.	9/10/07 1530	Surface	22.7	0.09	7.4	7.2	0.193
8) North End of Union Lake	9/12/07 1121	Surface	20.3	0.08	7.3	7.7	0.176
9) Union Lake Beach	9/12/07 1214	Surface	25.2	0.07	7.0	7.6	0.159
10) South End of Union Lake Beach	9/12/2007 1447	Surface	25.3	0.07	7.2	7.6	0.160
1) West of Mill Rd	11/02/06 0855	Surface	12.9	0.04	5.4	6.7	0.073
2) West of Rte 55	11/02/06 0940	Surface	12.8	0.05	7.6	6.6	0.089
3) BWB & Maurice Confluence	11/02/06 1047	Surface	12.3	0.04	7.6	6.1	0.068
4) Alliance Beach	11/02/06 1144	Surface	12.5	0.04	7.9	6.2	0.069
5) Almond Beach	11/01/06 1655	Surface	13.0	0.04	5.5	6.0	0.070
6) "BareA" Beach	11/01/06 1600	Surface	12.9	0.04	5.6	6.3	0.071
7) Sherman Ave.	11/01/06 1443	Surface	13.1	0.06	5.8	7.0	0.106
8) North End of Union Lake	11/01/06 1140	Surface	12.3	0.06	6.0	6.7	0.092
9) Union Lake Beach	11/01/06 1230	Surface	11.3	0.06	6.4	7.7	0.087
10) South End of Union Lake Beach	11/01/06 1300	Surface	12.9	0.06	6.8	8.3	0.093
1) West of Mill Rd	5/23/06 0840*	Surface	12.7	0.08	9.8	7.1	0.137
2) West of Rte 55	5/23/06 1808*	Surface	17.4	0.08	10.2	6.9	0.145
3) BWB & Maurice Confluence	5/25/06 0849*	Surface	17	0.05	8.8	7.2	0.098
4) Alliance Beach	5/23/06 1340*	Surface	17	0.07	9.9	6.9	0.126
5) Almond Beach	5/23/06 1453*	Surface	17.6	0.07	10.3	6.9	0.123
6) "BareA" Beach	5/23/06 1535*	Surface	17.7	0.05	10.1	6.8	0.101
7) Sherman Ave.	5/23/06 1710*	Surface	17.7	0.08	9.5	7.1	0.148
8) North End of Union Lake	5/24/06 1157*	Surface	15.8	0.07	10.0	6.9	0.116
9) Union Lake Beach	5/24/06 1318*	Surface	19	0.06	10.1	7.3	0.117
10) South End of Union Lake Beach	5/24/06 1642*	Surface	20	0.06	10.5	7.7	0.111
4) Alliance Beach	5/1999**	unknown	15.1	0.0	8.9	6.3	0.079
5) Almond Beach	5/1999**	unknown	13.5	0.0	8.7	6.4	0.077
6) "BareA" Beach	5/1999**	unknown	14.6	0.0	9.7	5.8	0.079
9) Union Lake Beach	5/1999**	unknown	16.9	0.0	9.7	5.7	0.091
10) South End of Union Lake Beach	5/1999**	unknown	15.3	0.0	9.4	5.9	0.093

**May 1999 data were referenced from (USEPA /ERTC 1999) citation

TABLE 2-4. DUPLICATE, EQUIPMENT BLANK, AND MATRIX SPIKE SAMPLES COLLECTED IN VICINITY OF VINELAND CHEMICAL SUPERFUND SITE, APRIL 2010

VINELAND PERIODIC SAMPLING - SPRING 2010

Sample Location	Station ID		Date Collected	Matrix
	Sample ID	Duplicate Cross-Referenced Station		
Field Duplicate	DUP-1	Almond-Shore	4/7/2010	Sediment
	DUP-2	Almond-Sed	4/7/2010	Sediment
	DUP-3	SUL-Beach	4/6/2010	Sediment
	DUP-4	BA-Wat2	4/7/2010	Aqueous
	DUP-5	Almond-Wat2	4/7/2010	Aqueous
Equipment Blank	PBlank-01	N/A	4/6/2010	Aqueous
	PBlank-02	N/A	4/7/2010	Aqueous
	PBlank-03	N/A	4/8/2010	Aqueous
	TTBlank	N/A	4/7/2010	Aqueous
Matrix Spikes (MS) and Matrix Spike Duplicates (MSD)	Almond-Wat1-MS	N/A	4/7/2010	Aqueous
	Almond-Wat1-MSD	N/A	4/7/2010	Aqueous
	BA-Beach-MS	N/A	4/7/2010	Sediment
	BA-Beach-MSD	N/A	4/7/2010	Sediment
	ULB-Beach-MS	N/A	4/6/2010	Sediment
	ULB-Beach-MSD	N/A	4/6/2010	Sediment
	Almond-Beach-MS	N/A	4/7/2010	Sediment
	Almond-Beach-MSD	N/A	4/7/2010	Sediment

TABLE 2-5. COORDINATES AND LOCATION INFORMATION FOR SEDIMENT AND WATER SAMPLES COLLECTED AT ADDITIONAL BEACH TRANSECTS, VINELAND CHEMICAL SUPERFUND SITE, APRIL 2010

Sample Location	Sample ID	Northing*	Easting*	Water Depth (ft)	Approximate Distance Offshore (ft)
4) Alliance Beach	ALLIANCET1-1	243960.7	328590.1	3	38
	ALLIANCET1-2	243962.9	328581.5	2.5	28.5
	ALLIANCET1-3	243966.4	328574.0	1.9	19
	ALLIANCET1-4	243970.7	328568.0	2.3	9.5
	ALLIANCET1-5	243976.4	328557.6	0	0
	ALLIANCET1-WAT1	243960.7	328590.1	3	38
	ALLIANCET1-WAT2	243960.7	328590.1	3	38
	ALLIANCET1-WAT3	243976.4	328557.6	0	0
	ALLIANCET1-WAT4	243976.4	328557.6	0	0
	ALLIANCET2-1	243915.0	328574.8	3	35
	ALLIANCET2-2	243917.5	328568.5	2.75	26
	ALLIANCET2-3	243919.6	328560.3	2.4	17
	ALLIANCET2-4	243922.4	328553.2	1.6	8
	ALLIANCET2-5	243925.9	328544.3	0	0
	ALLIANCET2-WAT1	243915.0	328574.8	3	35
	ALLIANCET2-WAT2	243915.0	328574.8	3	35
	ALLIANCET2-WAT3	243925.9	328544.3	0	0
	ALLIANCET2-WAT4	243925.9	328544.3	0	0
5) Almond Beach	ALMONDT1-1	241832.4	329508.3	2.7	50
	ALMONDT1-2	241833.1	329518.2	2.4	38
	ALMONDT1-3	241837.0	329525.1	2.4	26
	ALMONDT1-4	241838.7	329534.8	2.3	14
	ALMONDT1-5	241837.3	329552.5	0	0
	ALMONDT1-WAT1	241832.4	329508.3	2.7	50
	ALMONDT1-WAT2	241832.4	329508.3	2.7	50
	ALMONDT1-WAT3	241837.3	329552.5	0	0
	ALMONDT1-WAT4	241837.3	329552.5	0	0
	ALMONDT2-1	241884.6	329524.8	3.3	26
	ALMONDT2-2	241882.1	329531.4	2.65	19.5
	ALMONDT2-3	241885.8	329537.0	2.2	13
	ALMONDT2-4	241884.0	329544.5	1.5	6.5
	ALMONDT2-5	241889.4	329550.5	0	0
	ALMONDT2-WAT1	241884.6	329524.8	3.3	26
	ALMONDT2-WAT2	241884.6	329524.8	3.3	26
	ALMONDT2-WAT3	241889.4	329550.5	0	0
	ALMONDT2-WAT4	241889.4	329550.5	0	0
6) "Bare A" Beach	BAT1-1	237978.5	330371.4	3	19
	BAT1-2	237979.3	330372.8	2.5	14.5
	BAT1-3	237978.8	330375.5	2.2	10
	BAT1-4	237980.1	330380.8	2.2	5.5
	BAT1-5	237979.1	330387.7	0.6	0
	BAT1-WAT1	237978.5	330371.4	3	19
	BAT1-WAT2	237978.5	330371.4	3	19
	BAT1-WAT3	237979.1	330387.7	0.6	0
	BAT1-WAT4	237979.1	330387.7	0.6	0
	BAT2-1	238001.7	330370.2	3.6	20
	BAT2-2	238007.2	330372.3	2.6	15
	BAT2-3	238007.5	330376.3	2.5	10
	BAT2-4	238007.2	330381.1	1.7	5
	BAT2-5	238011.1	330382.7	0.7	0
	BAT2-WAT1	238001.7	330370.2	3.6	20
	BAT2-WAT2	238001.7	330370.2	3.6	20
	BAT2-WAT3	238011.1	330382.7	0.7	0
	BAT2-WAT4	238011.1	330382.7	0.7	0

TABLE 2-5. (CONTINUED)

Sample Location	Sample ID	Northing*	Easting*	Water Depth (ft)	Approximate Distance Offshore (ft)
9) Union Lake Beach	ULBT1-1	210370.1	335317.9	2.7	66
	ULBT1-2	210358.9	335323.7	2.65	53
	ULBT1-3	210351.6	335336.3	2.4	40
	ULBT1-4	210342.9	335343.9	1.9	27
	ULBT1-5	210316.3	335357.1	0	0
	ULBT1-WAT1	210370.1	335317.9	2.7	66
	ULBT1-WAT2	210370.1	335317.9	2.7	66
	ULBT1-WAT3	210316.3	335357.1	0	0
	ULBT1-WAT4	210316.3	335357.1	0	0
	ULBT2-1	210436.6	335363.1	2.8	51
	ULBT2-2	210427.5	335372.5	2.5	38
	ULBT2-3	210415.9	335380.4	2.1	25
	ULBT2-4	210403.1	335390.5	1.9	12
	ULBT2-5	210383.4	335410.9	0.6	0
	ULBT2-WAT1	210436.6	335363.1	2.8	51
	ULBT2-WAT2	210436.6	335363.1	2.8	51
	ULBT2-WAT3	210383.4	335410.9	0.6	0
	ULBT2-WAT4	210383.4	335410.9	0.6	0
10) South End Union Lake Beach	SULT1-1	208789.3	336509.1	3	42
	SULT1-2	208791.4	336516.9	2.5	32
	SULT1-3	208791.4	336525.6	1.9	22
	SULT1-4	208794.8	336534.5	1.2	12
	SULT1-5	208795.8	336546.6	0	0
	SULT1-WAT1	208789.3	336509.1	3	42
	SULT1-WAT2	208789.3	336509.1	3	42
	SULT1-WAT3	208795.8	336546.6	0	0
	SULT1-WAT4	208795.8	336546.6	0	0
	SULT2-1	208872.1	336488.9	2.9	41
	SULT2-2	208872.9	336497.0	2.3	32
	SULT2-3	208873.4	336503.5	1.9	23
	SULT2-4	208874.9	336516.1	1.4	14
	SULT2-5	208873.5	336530.1	0.4	0
	SULT2-WAT1	208872.1	336488.9	2.9	41
	SULT2-WAT2	208872.1	336488.9	2.9	41
	SULT2-WAT3	208873.5	336530.1	0.4	0
	SULT2-WAT4	208873.5	336530.1	0.4	0

* - coordinates are in New Jersey State Plane (ft), NAD83

TABLE 2-6. SUMMARY OF SEDIMENT AND WATER SAMPLES COLLECTED AT ADDITIONAL BEACH TRANSECTS, VINELAND CHEMICAL SUPERFUND SITE, APRIL 2010

Sample Location (Name)	Sample Date	Type and Number of Samples	
		Sediment	Water (wat1/wat2/wat3/wat4)*
		Arsenic	Arsenic
4) Alliance Beach (ALLIANCE)	11/18/2009	10 + 2 DUP+2 MS, 2 MSD	8 + 2 DUP+2 MS, 2 MSD
5) Almond Beach (ALMOND)	11/18/2009	10 + 2 DUP+2 MS, 2 MSD	8+ 2 DUP+2 MS, 2 MSD
6) "BareA" Beach (BA)	11/18/2009	10 + DUP+MS, MSD	8
9) Union Lake Beach (ULB)	11/19/2009	10	8
10) South End Union Lake Beach (SUL)	11/19/2009	10	8
NUMBER OF SAMPLES	-	**50**	**40**
NUMBER OF QC SAMPLES	-	**10**	**12**
TOTAL NUMBER OF SAMPLES	-	**60**	**52**

Arsenic Samples:	**Sediment**	**Water**
Sample Volume	1 x 250 g	1 x 250 ml
Holding Time	6 months	6 months
Preservative/Temperature	$4^{o}C$	HNO_3 to pH <2, $4^{o}C$
Extraction/Analysis Methodologies	USEPA DESA SOP C-116/C-109	USEPA DESA SOP C-116/C-109

NOTE:

QC sample duplicates were collected and analyzed for each media at a rate of approximately 10% per sample matrix per analysis per sample event.

* - Wat1 and Wat3 represent pre-agitated water samples; Wat2 and Wat4 represent post-agitated water samples

3. RESULTS

The Periodic Sampling – Spring 2010 results for each station and sampling matrix are presented in Figure 3-1. Arsenic results by individual station locations are presented in Figures 3-2 through 3-7. Results for the additional beach transects are presented in Figures 3-5 to 3-9. Detected arsenic concentrations in surface water samples were compared to the USEPA Drinking Water Criterion for arsenic of 10 parts per billion (ppb or µg/L), and the results for detected arsenic concentrations in sediment and soil were compared to the Site Clean-up Level of 20 parts per million (ppm or mg/Kg). The Site Clean-up Level of 20 ppm is based upon the New Jersey Residential Clean-up Standard for Arsenic. The laboratory report and the accompanying COC forms are provided in Appendix A.

3.1 WATER

3.1.1 *In Situ* Water Quality

Water quality measurements were recorded *in situ* at each of the eight locations where surface water samples were collected for chemical analysis (mid-stream/mid-depth of the water column) (Table 2-3). Table 2-3 also includes *in situ* water quality data collected during the November 2009 (EA 2010), May 2009 (EA 2009), September 2007 (EA 2008), November 2006 (EA 2007), May 2006 (EA 2006a), and May 1999 (USEPA/ERTC 1999) field collections at the site for comparison. The *in situ* water quality results were within the expected range of parameters for a freshwater system in New Jersey. Water temperature ranged from 13.8 to 21.2 degrees Celsius, salinity ranged from 0.05 to 0.06 parts per thousand (ppt), dissolved oxygen ranged from 6.2 to 10.3 mg per liter (mg/L), pH ranged from 6.2 to 6.6, and conductivity ranged from 0.099 to 0.111 mS/cm.

3.1.2 Surface Water (Periodic Sampling - Spring 2010)

Surface water samples were collected from eight locations along Blackwater Branch, the Maurice River, and Union Lake (Figures 3-1 through 3-7). At each location, one surface water sample was collected prior to any disturbance of bottom sediment (referred to as sample one – Wat1) and the second surface water sample was collected at the same location as above after disturbance of the bottom sediment (referred to as sample two – Wat2), intended to simulate potential human exposure to arsenic during recreational contact. Therefore, a total of 16 surface water samples were collected from eight locations in the vicinity of the site. Six of the 16 surface water samples analyzed had detected concentrations of arsenic that were above the 10 ppb (µg/L) USEPA Drinking Water Criterion for arsenic. Five of the exceedences occurred in the agitated surface water samples, with arsenic concentrations of 58 µg/L at Station 3 (Blackwater Branch confluence), 370 µg/L at Station 6 ("Bare A" Beach), 76 µg/L at Station 8 (North End of Union Lake), 120 µg/L at Station 9 (Union Lake Beach), and 14 µg/L at Station 10 (South End of Union Lake). The non-agitated sample (Wat1) at Station 9 (Union Lake Beach) had an arsenic concentration of 14 µg/L which exceeded the USEPA Drinking Water Criterion for arsenic. Station 6 had a detected concentration of arsenic below the 10 ppb USEPA Drinking Water Criterion in the non-agitated (Wat1) samples. The remaining stations did not have detected concentrations of arsenic (Table 3-1). The agitated surface water field duplicate

taken at Station 6 had an exceedance with an arsenic concentration of 590 µg/L. The second agitated surface water field duplicate taken at Station 5 (Almond Beach) had a non-detect of arsenic (Table 3-1).

3.1.3 Surface Water (Additional Beach Transects)

Surface water was collected from five beach locations consisting of two transects per beach. At each transect surface water with sample names ending in WAT1 and WAT2 was collected at the sampling location located farthest offshore; a second set of surface water samples, with sample names ending in WAT3 and WAT4, was collected at the sampling location located near the shoreline. Sample names ending with WAT1 and WAT3 refer to non-agitated samples; sample name ending with WAT2 and WAT4 were agitated samples. Table 3-3 and Figures 3-5 to 3-9 present the results of sampling.

A total of 40 surface water samples were collected for the additional beach transect sampling effort. Arsenic was detected in eight of the 40 samples; all detected concentrations were in agitated samples. Arsenic concentrations in the eight samples exceeded the USEPA Drinking Water Criterion of 10 ppb. The samples with arsenic detections included Station 4 (Alliance Beach), Station 6 ("Bare A" Beach), Station 9 (Union Lake Beach), and Station 10 (South End of Union Lake). Detected arsenic concentrations ranged from 11 µg/L to 150 µg/L; four of the eight exceedances occurred at Station 6. None of the non-agitated surface water samples had any detected arsenic.

3.2 SEDIMENT AND SOIL

3.2.1 Shallow Sediment (Periodic Sampling – Spring 2010)

Two types of shallow and nearshore (shore) sediment samples were collected, including in-stream and nearshore (shore) sediment samples (Figures 3-2 through 3-7). The results are presented in the following paragraphs and Table 3-2. The shallow sediment samples were intended to simulate potential human exposure to arsenic contaminated sediment during recreational contact (i.e., beach wading, playing in shallow near shore water, a special concern regarding children).

3.2.1.1 In-Stream Sediment

In-stream sediment samples (0-0.5 ft depth increment beneath the surface water/sediment interface) were collected from eight locations along Blackwater Branch, the Maurice River, and Union Lake (Figures 3-1 through 3-7). Arsenic was detected in the shallow sediment samples at each of the eight locations, ranging from 1.2 mg/Kg to 410 mg/Kg (Table 3-2). At three locations, in-stream arsenic concentrations in sediment exceeded the Site Clean-up Level of 20 ppm (mg/Kg): Station 6 ("Bare A" Beach) (120 mg/Kg), Station 8 (North End of Union Lake Beach) (410 mg/Kg), and Station 9 (Union Lake Beach) (330 mg/Kg).

3.2.1.2 Nearshore (Shore) Sediment

Nearshore (shore) sediment samples were collected from eight locations along Blackwater Branch, the Maurice River and Union Lake, 2-10 ft below the waterline, representing the 0-0.5 ft depth increment beneath the surface water/sediment interface (Figures 3-1 through 3-7). Arsenic was detected in seven of the eight shore sediment samples, ranging from 0.84 mg/Kg to 160 mg/Kg (Table 3-2). At three locations, nearshore arsenic concentrations in sediment exceeded the Site Clean-up Level of 20 ppm for arsenic in solids. Arsenic exceeded the 20 ppm criterion at Station 3 (Blackwater Branch confluence) (150 mg/Kg), Station 6 ("BareA" Beach) (160 mg/Kg), and Station 8 (North End of Union Lake) (110 mg/Kg). Arsenic was not detected in shore sediment at Station 5 (Almond Beach).

3.2.2 Beach Soils

Beach soils were sampled from a total of five locations along the Maurice River and Union Lake (Figures 3-2, 3-3, 3-4, and 3-7). Arsenic was only detected at three of the five beach locations; none of the detected concentrations exceeded the Site Clean-up Level of 20 ppm for arsenic in solids (Table 3-2). Arsenic was not detected in beach soils at Station 5 (Almond Beach) and Station 6 ("Bare A" Beach).

3.2.3 Sediment (Additional Beach Transects)

Table 3-4 and Figures 3-5 to 3-9 show the results of sediment sampling at the five beach locations. Two transects were sampled at each beach location. Five sediment samples were collected at each transect for a total of 50 additional beach transect sediment samples. Of the 50 sediment samples collected, arsenic was detected in 42 samples. Arsenic was detected at concentrations below the Site Clean-up Level of 20 ppm in 34 samples. Eight samples had arsenic detected at concentrations above the Site Clean-up Level of 20 ppm; arsenic concentrations exceeding 20 ppm ranged from 26 mg/Kg to 450 mg/Kg. All of the samples exceeding 20 ppm were located at Station 6 ("Bare A" Beach).

3.3 QA/QC RESULTS (Periodic Sampling – Spring 2010)

The results for the QA/QC samples, including equipment blanks and field duplicates are provided in Tables 3-1 and 3-2, respectively, and are discussed in the following subsections.

3.3.1 Equipment Blanks

Arsenic was not detected at concentrations above the Method Detection Limit (MDL - 8 µg/L) in any of the equipment blanks (Table 3-1). Therefore, it is unlikely that any contamination can be attributed to sampling equipment or collection and handling.

3.3.2 Field Duplicates

Field duplicate samples were collected simultaneously from the same sampling locations as sediment and surface water samples.

Relative percent differences (RPD) were calculated for field duplicate samples that had detected concentrations of arsenic. Following the protocol defined in Worksheet 12 of the *UFP/QAPP* (USACE 2009), the RPD was calculated for DUP-2 and DUP-4. RPDs were not calculated for duplicates and co-located samples with non-detect results. According to the *UFP/QAPP* (USACE 2009), the measurement performance criterion for sediment samples and aqueous samples was 25% RPD (QAPP Worksheets 12-1 and 12-2).

The RPD was for DUP-2 was less than 25%. The RPD for DUP-4 was 45.8% which was out of compliance with the measurement performance criteria. The difference in arsenic concentrations between DUP-4 and BA-WAT2 is due to the variability in collecting agitated surface water samples (manually disturbing the sediment to simulate potential human exposure) thus resulting in a RPD value above the 25% performance criterion.

Type of Sample	**Duplicate # / Result**	**Matching Sampling ID / Result**	**RPD for detected analytes**
Sediment	DUP-1/(U)	Almond-Shore (U)	NC
Sediment	DUP-2/(1.0 mg/Kg)	Almond-Sed (1.2 mg/Kg)	18.2%
Sediment	DUP-3/(U)	SUL-Beach (0.53 mg/Kg)	NC
Aqueous	DUP-4/(590 µg/L)	BA-Wat2 (370 µg/L)	45.8%
Aqueous	DUP-5/(U)	Almond-Wat2 ((U)	NC

U = non-detected arsenic concentration
NC = not calculated due to non-detected results

3.3.3 MS/MSD Samples

The Laboratory's established QC criteria were met for MS and MSD samples, including aqueous samples, soil samples, and sediment samples. These data were validated by the USEPA Region II DESA Laboratory.

3.3.4 Completeness

Completeness is a measure of the amount of usable data obtained during the project compared to the amount that was expected to be obtained (Worksheet #12 in the *UFP/QAPP).* For the Periodic Sampling – Spring 2010 and Additional Beach Transect sampling, technical completeness was 100%. All results of arsenic analysis were usable for both sampling efforts.

3.4 QA/QC RESULTS (Additional Beach Transects)

3.4.1 Field Duplicates

Field duplicate samples were collected simultaneously from the same sampling locations as sediment and surface water samples. Following the protocol described in Section 3.3.2 RPD values were calculated field duplicate samples that had detected concentrations of arsenic.

The RPD value for SED-DUP5 and its matching sample were below the measurement performance criterion of 25%. SED-DUP4 and WATER-DUP2 were outside of the measurement performance criterion. The arsenic concentrations detected in SED-DUP4 and AlmondT2-5 were close to the average reporting limit for sediment samples. The small difference is sample results translated to a high RPD. However, due to the heterogeneity of sediment, the RPD is not a significant deviation and the sample results are still acceptable. The arsenic concentrations for SED-DUP4 and AlmondT2-5 were well below the Site Clean-up Level of 20 ppm.

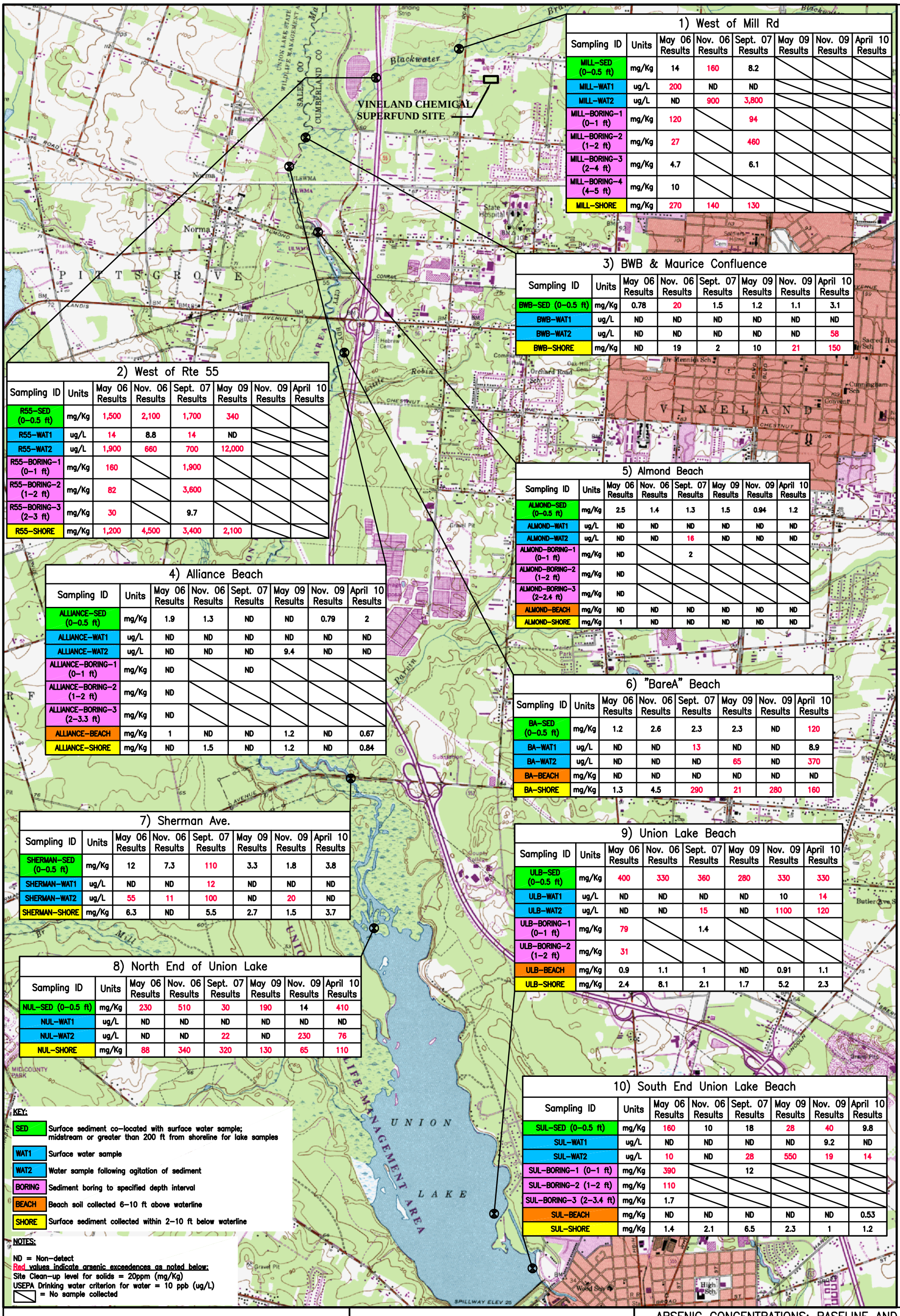
The difference in arsenic concentrations between WATER-DUP2 and AllianceT2-Wat4 is due to the variability in collecting post-agitated surface water samples (manually disturbing the sediment to simulate potential human exposure) thus resulting in a RPD value above the 25% performance criterion.

Type of Sample	**Duplicate # / Result**	**Matching Sampling ID / Result**	**RPD for detected analytes**
Sediment	SED-DUP1 (U)	AllianceT1-5 (U)	NC
Sediment	SED-DUP2 (0.55 mg/Kg)	AllianceT2-5 (U)	NC
Sediment	SED-DUP3 (U)	AlmondT1-5 (U)	NC
Sediment	SED-DUP4 (1.1 mg/Kg)	AlmondT2-5 (1.5 mg/Kg)	30.8%
Sediment	SED-DUP5 (29 mg/Kg)	BAT1-5 (26 mg/Kg)	10.9%
Aqueous	WATER-DUP1 (U)	AllianceT1-Wat4 (U)	NC
Aqueous	WATER-DUP2 (8.3 µg/L)	AllianceT2-Wat4 (12 µg/L)	36.4%
Aqueous	WATER-DUP3 (U)	AlmondT1-Wat4 (U)	NC
Aqueous	WATER-DUP4 (U)	AlmondT2-Wat4 (U)	NC

U = non-detected arsenic concentration
NC = not calculated due to non-detected results

3.4.2 MS/MSD Samples

The Laboratory's established QC criteria were met for MS and MSD samples, including aqueous samples and sediment samples. These data were validated by the USEPA Region II DESA Laboratory.



1) West of Mill Rd

Sampling ID	Units	May 06 Results	Nov. 06 Results	Sept. 07 Results	May 09 Results	Nov. 09 Results	April 10 Results
MILL-SED (0-0.5 ft)	mg/Kg	14	160	8.2			
MILL-WAT1	ug/L	200	ND	ND			
MILL-WAT2	ug/L	ND	900	3,800			
MILL-BORING-1 (0-1 ft)	mg/Kg	120		94			
MILL-BORING-2 (1-2 ft)	mg/Kg	27		460			
MILL-BORING-3 (2-4 ft)	mg/Kg	4.7		6.1			
MILL-BORING-4 (4-5 ft)	mg/Kg	10					
MILL-SHORE	mg/Kg	270	140	130			

2) West of Rte 55

Sampling ID	Units	May 06 Results	Nov. 06 Results	Sept. 07 Results	May 09 Results	Nov. 09 Results	April 10 Results
R55-SED (0-0.5 ft)	mg/Kg	1,500	2,100	1,700	340		
R55-WAT1	ug/L	14	8.8	14	ND		
R55-WAT2	ug/L	1,900	660	700	12,000		
R55-BORING-1 (0-1 ft)	mg/Kg	160		1,900			
R55-BORING-2 (1-2 ft)	mg/Kg	82		3,600			
R55-BORING-3 (2-3 ft)	mg/Kg	30		9.7			
R55-SHORE	mg/Kg	1,200	4,500	3,400	2,100		

3) BWB & Maurice Confluence

Sampling ID	Units	May 06 Results	Nov. 06 Results	Sept. 07 Results	May 09 Results	Nov. 09 Results	April 10 Results
BWB-SED (0-0.5 ft)	mg/Kg	0.78	20	1.5	1.2	1.1	3.1
BWB-WAT1	ug/L	ND	ND	ND	ND	ND	ND
BWB-WAT2	ug/L	ND	ND	ND	ND	ND	58
BWB-SHORE	mg/Kg	ND	19	2	10	21	150

4) Alliance Beach

Sampling ID	Units	May 06 Results	Nov. 06 Results	Sept. 07 Results	May 09 Results	Nov. 09 Results	April 10 Results
ALLIANCE-SED (0-0.5 ft)	mg/Kg	1.9	1.3	ND	ND	0.79	2
ALLIANCE-WAT1	ug/L	ND	ND	ND	ND	ND	ND
ALLIANCE-WAT2	ug/L	ND	ND	ND	9.4	ND	ND
ALLIANCE-BORING-1 (0-1 ft)	mg/Kg	ND		ND			
ALLIANCE-BORING-2 (1-2 ft)	mg/Kg	ND					
ALLIANCE-BORING-3 (2-3.3 ft)	mg/Kg	ND					
ALLIANCE-BEACH	mg/Kg	1	ND	ND	1.2	ND	0.67
ALLIANCE-SHORE	mg/Kg	ND	1.5	ND	1.2	ND	0.84

5) Almond Beach

Sampling ID	Units	May 06 Results	Nov. 06 Results	Sept. 07 Results	May 09 Results	Nov. 09 Results	April 10 Results
ALMOND-SED (0-0.5 ft)	mg/Kg	2.5	1.4	1.3	1.5	0.94	1.2
ALMOND-WAT1	ug/L	ND	ND	ND	ND	ND	ND
ALMOND-WAT2	ug/L	ND	ND	16	ND	ND	ND
ALMOND-BORING-1 (0-1 ft)	mg/Kg	ND		2			
ALMOND-BORING-2 (1-2 ft)	mg/Kg	ND					
ALMOND-BORING-3 (2-2.4 ft)	mg/Kg	ND					
ALMOND-BEACH	mg/Kg	ND	ND	ND	ND	ND	ND
ALMOND-SHORE	mg/Kg	1	ND	ND	ND	ND	ND

6) "BareA" Beach

Sampling ID	Units	May 06 Results	Nov. 06 Results	Sept. 07 Results	May 09 Results	Nov. 09 Results	April 10 Results
BA-SED (0-0.5 ft)	mg/Kg	1.2	2.6	2.3	2.3	ND	120
BA-WAT1	ug/L	ND	ND	13	ND	ND	8.9
BA-WAT2	ug/L	ND	ND	ND	65	ND	370
BA-BEACH	mg/Kg	ND	ND	ND	ND	ND	ND
BA-SHORE	mg/Kg	1.3	4.5	290	21	280	160

7) Sherman Ave.

Sampling ID	Units	May 06 Results	Nov. 06 Results	Sept. 07 Results	May 09 Results	Nov. 09 Results	April 10 Results
SHERMAN-SED (0-0.5 ft)	mg/Kg	12	7.3	110	3.3	1.8	3.8
SHERMAN-WAT1	ug/L	ND	ND	12	ND	ND	ND
SHERMAN-WAT2	ug/L	55	11	100	ND	20	ND
SHERMAN-SHORE	mg/Kg	6.3	ND	5.5	2.7	1.5	3.7

8) North End of Union Lake

Sampling ID	Units	May 06 Results	Nov. 06 Results	Sept. 07 Results	May 09 Results	Nov. 09 Results	April 10 Results
NUL-SED (0-0.5 ft)	mg/Kg	230	510	30	190	14	410
NUL-WAT1	ug/L	ND	ND	ND	ND	ND	ND
NUL-WAT2	ug/L	ND	ND	22	ND	230	76
NUL-SHORE	mg/Kg	88	340	320	130	65	110

9) Union Lake Beach

Sampling ID	Units	May 06 Results	Nov. 06 Results	Sept. 07 Results	May 09 Results	Nov. 09 Results	April 10 Results
ULB-SED (0-0.5 ft)	mg/Kg	400	330	360	280	330	330
ULB-WAT1	ug/L	ND	ND	ND	ND	10	14
ULB-WAT2	ug/L	ND	ND	15	ND	1100	120
ULB-BORING-1 (0-1 ft)	mg/Kg	79		1.4			
ULB-BORING-2 (1-2 ft)	mg/Kg	31					
ULB-BEACH	mg/Kg	0.9	1.1	1	ND	0.91	1.1
ULB-SHORE	mg/Kg	2.4	8.1	2.1	1.7	5.2	2.3

10) South End Union Lake Beach

Sampling ID	Units	May 06 Results	Nov. 06 Results	Sept. 07 Results	May 09 Results	Nov. 09 Results	April 10 Results
SUL-SED (0-0.5 ft)	mg/Kg	160	10	18	28	40	9.8
SUL-WAT1	ug/L	ND	ND	ND	ND	9.2	ND
SUL-WAT2	ug/L	10	ND	28	550	19	14
SUL-BORING-1 (0-1 ft)	mg/Kg	390		12			
SUL-BORING-2 (1-2 ft)	mg/Kg	110					
SUL-BORING-3 (2-3.4 ft)	mg/Kg	1.7					
SUL-BEACH	mg/Kg	ND	ND	ND	ND	ND	0.53
SUL-SHORE	mg/Kg	1.4	2.1	6.5	2.3	1	1.2

KEY:

- **SED** — Surface sediment co-located with surface water sample; midstream or greater than 200 ft from shoreline for lake samples
- **WAT1** — Surface water sample
- **WAT2** — Water sample following agitation of sediment
- **BORING** — Sediment boring to specified depth interval
- **BEACH** — Beach soil collected 6-10 ft above waterline
- **SHORE** — Surface sediment collected within 2-10 ft below waterline

NOTES:

ND = Non-detect
Red values indicate arsenic exceedences as noted below:
Site Clean-up level for solids = 20ppm (mg/Kg)
USEPA Drinking water criterion for water = 10 ppb (ug/L)
= No sample collected

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VINELAND CHEMICAL SUPERFUND SITE
VINELAND, NJ

ARSENIC CONCENTRATIONS: BASELINE AND PERIODIC SAMPLING (2006), POST REMEDIAL ACTION SAMPLING (2007), AND PERIODIC SAMPLING (2009, 2010)

PROJECT MGR.	DESIGNED BY	DRAWN BY	CHECKED BY	DATE	SCALE	PROJECT NO.	FILE NAME	DRAWING NO.	FIGURE
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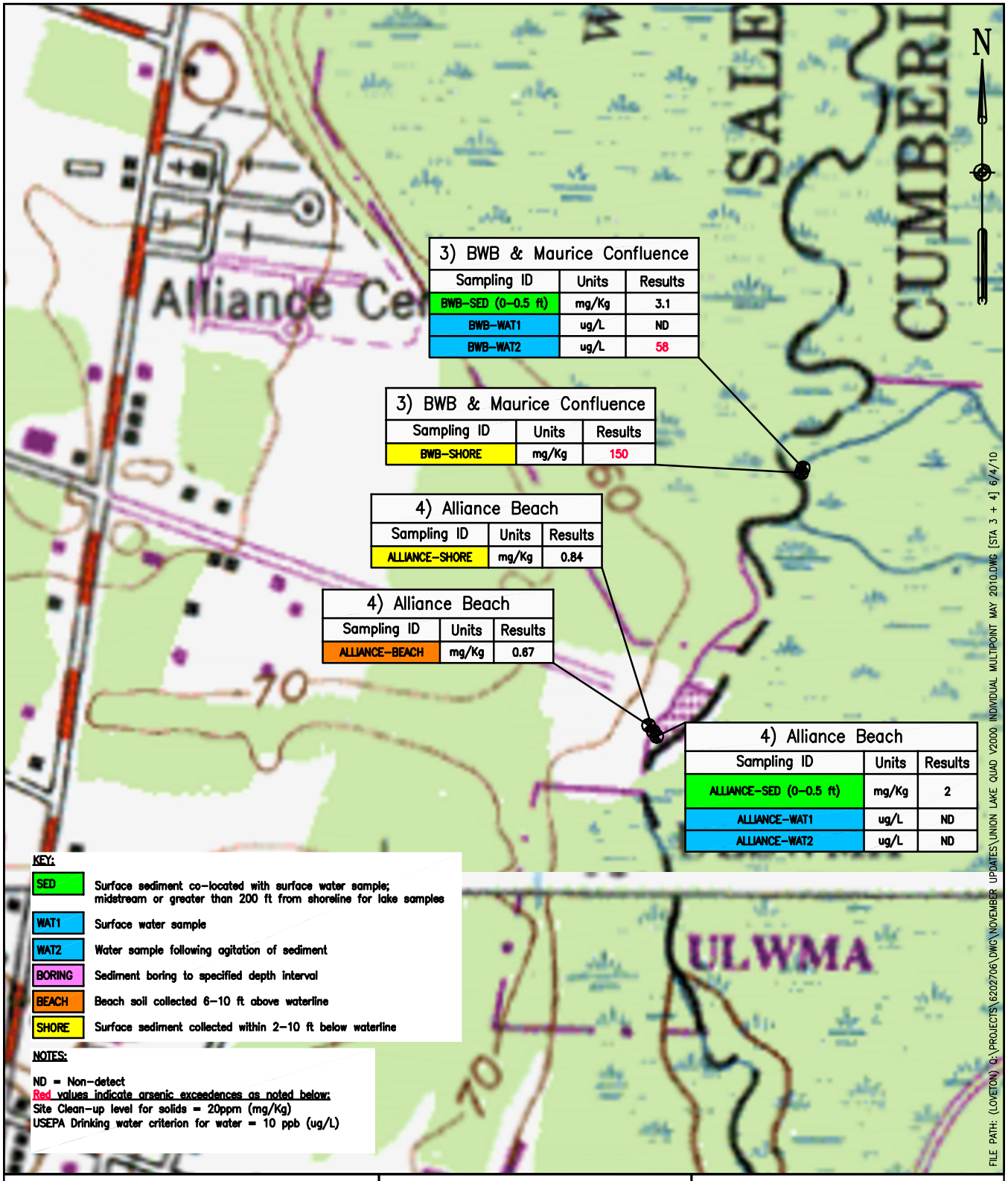
FILE PATH: (LOVETON) Q:\PROJECTS\6202706\DWG\NOVEMBER UPDATES\UNION LAKE QUAD FIG 3-1 MAY 2010.DWG [LAYOUT1] 6/4/10



3) BWB & Maurice Confluence		
Sampling ID	Units	Results
BWB-SED (0-0.5 ft)	mg/Kg	3.1
BWB-WAT1	ug/L	ND
BWB-WAT2	ug/L	58

3) BWB & Maurice Confluence		
Sampling ID	Units	Results
BWB-SHORE	mg/Kg	150

4) Alliance Beach		
Sampling ID	Units	Results
ALLIANCE-SHORE	mg/Kg	0.84

4) Alliance Beach		
Sampling ID	Units	Results
ALLIANCE-BEACH	mg/Kg	0.67

4) Alliance Beach		
Sampling ID	Units	Results
ALLIANCE-SED (0-0.5 ft)	mg/Kg	2
ALLIANCE-WAT1	ug/L	ND
ALLIANCE-WAT2	ug/L	ND

KEY:

SED	Surface sediment co-located with surface water sample; midstream or greater than 200 ft from shoreline for lake samples
WAT1	Surface water sample
WAT2	Water sample following agitation of sediment
BORING	Sediment boring to specified depth interval
BEACH	Beach soil collected 6-10 ft above waterline
SHORE	Surface sediment collected within 2-10 ft below waterline

NOTES:

ND = Non-detect
Red values indicate arsenic exceedences as noted below:
Site Clean-up level for solids = 20ppm (mg/Kg)
USEPA Drinking water criterion for water = 10 ppb (ug/L)

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VINELAND CHEMICAL SUPERFUND SITE
VINELAND, NJ

PERIODIC SAMPLING-SPRING 2010
SAMPLE LOCATIONS
3) BWB & MAURICE CONFLUENCE
AND 4) ALLIANCE BEACH

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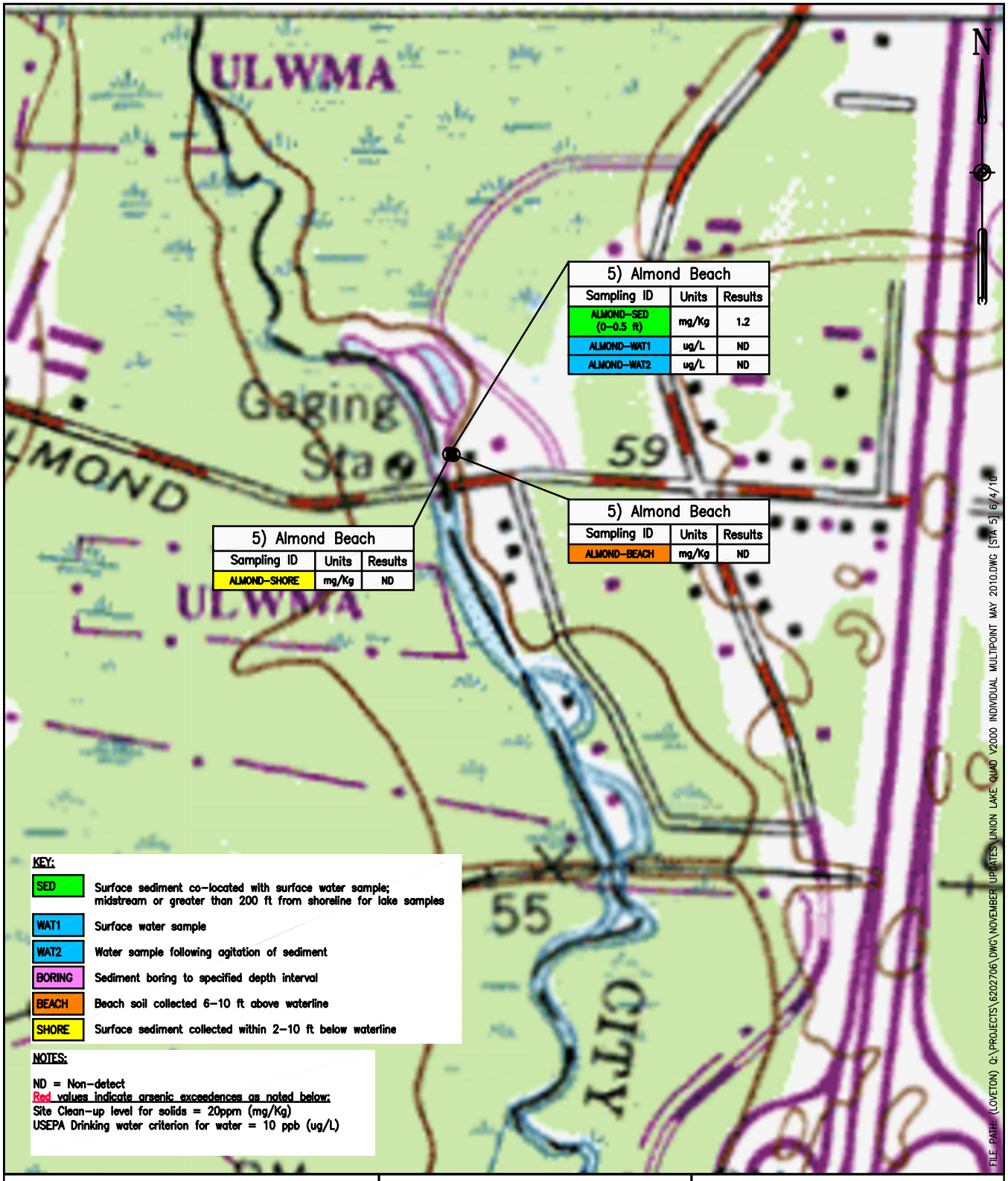

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VINELAND CHEMICAL SUPERFUND SITE
VINELAND, NJ

PERIODIC SAMPLING-SPRING 2010
SAMPLE LOCATION
5) ALMOND BEACH

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
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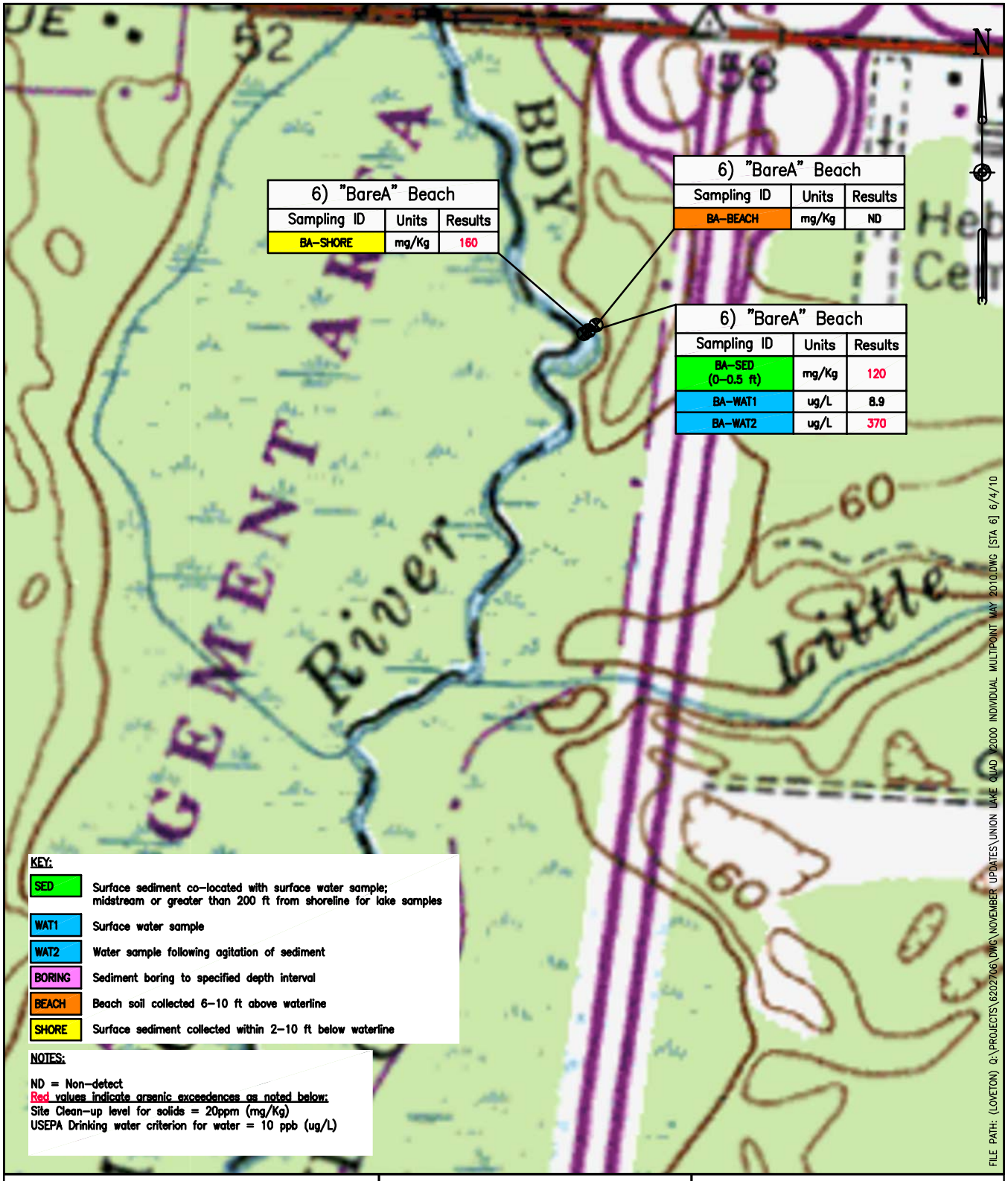

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VINELAND CHEMICAL SUPERFUND SITE
VINELAND, NJ

PERIODIC SAMPLING-SPRING 2010
SAMPLE LOCATION
6) "BARE A" BEACH

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
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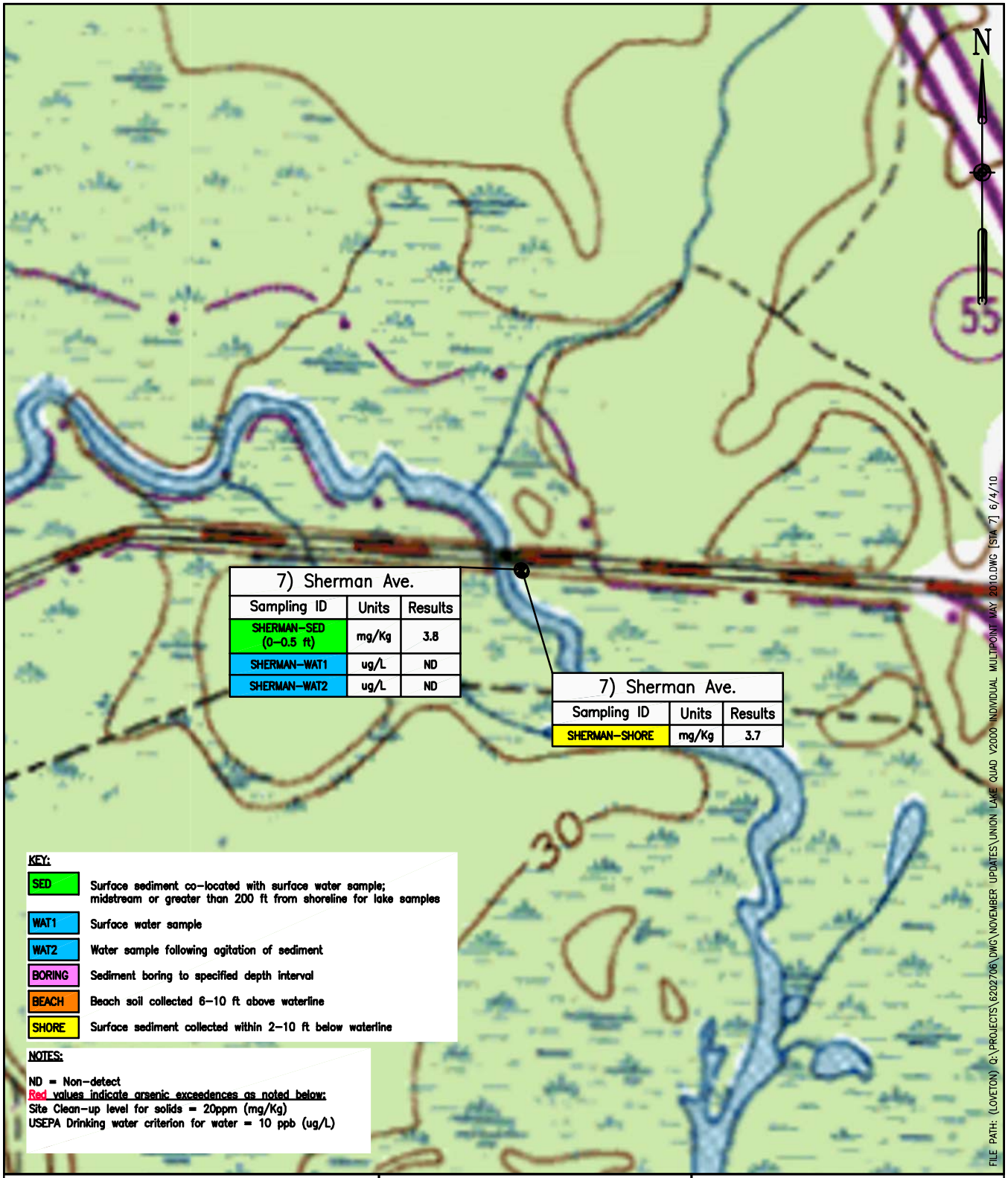

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VINELAND CHEMICAL SUPERFUND SITE
VINELAND, NJ

PERIODIC SAMPLING-SPRING 2010
SAMPLE LOCATION
7) SHERMAN AVE.

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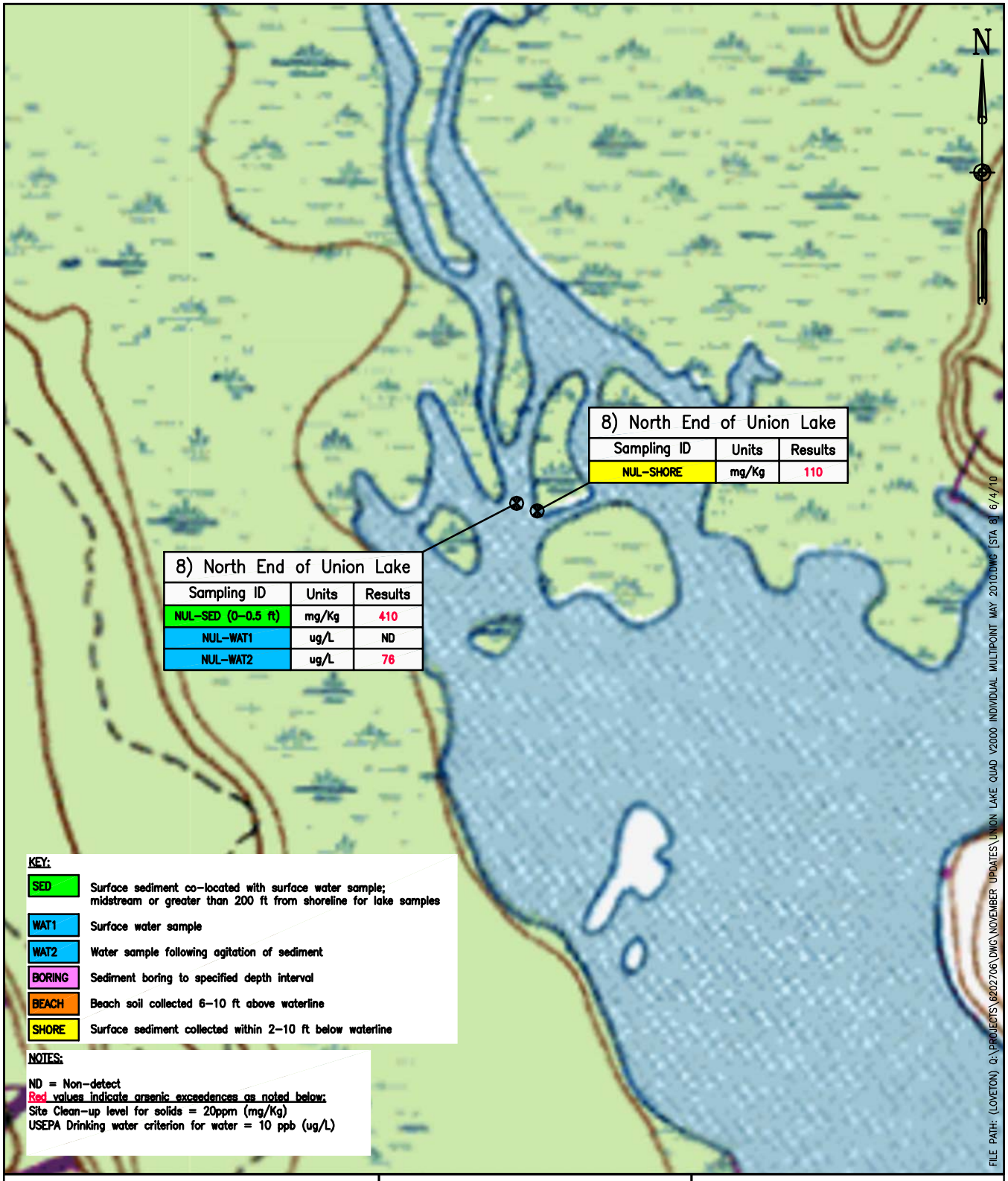

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VINELAND CHEMICAL SUPERFUND SITE
VINELAND, NJ

PERIODIC SAMPLING-SPRING 2010
SAMPLE LOCATION
8) NORTH END OF UNION LAKE

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
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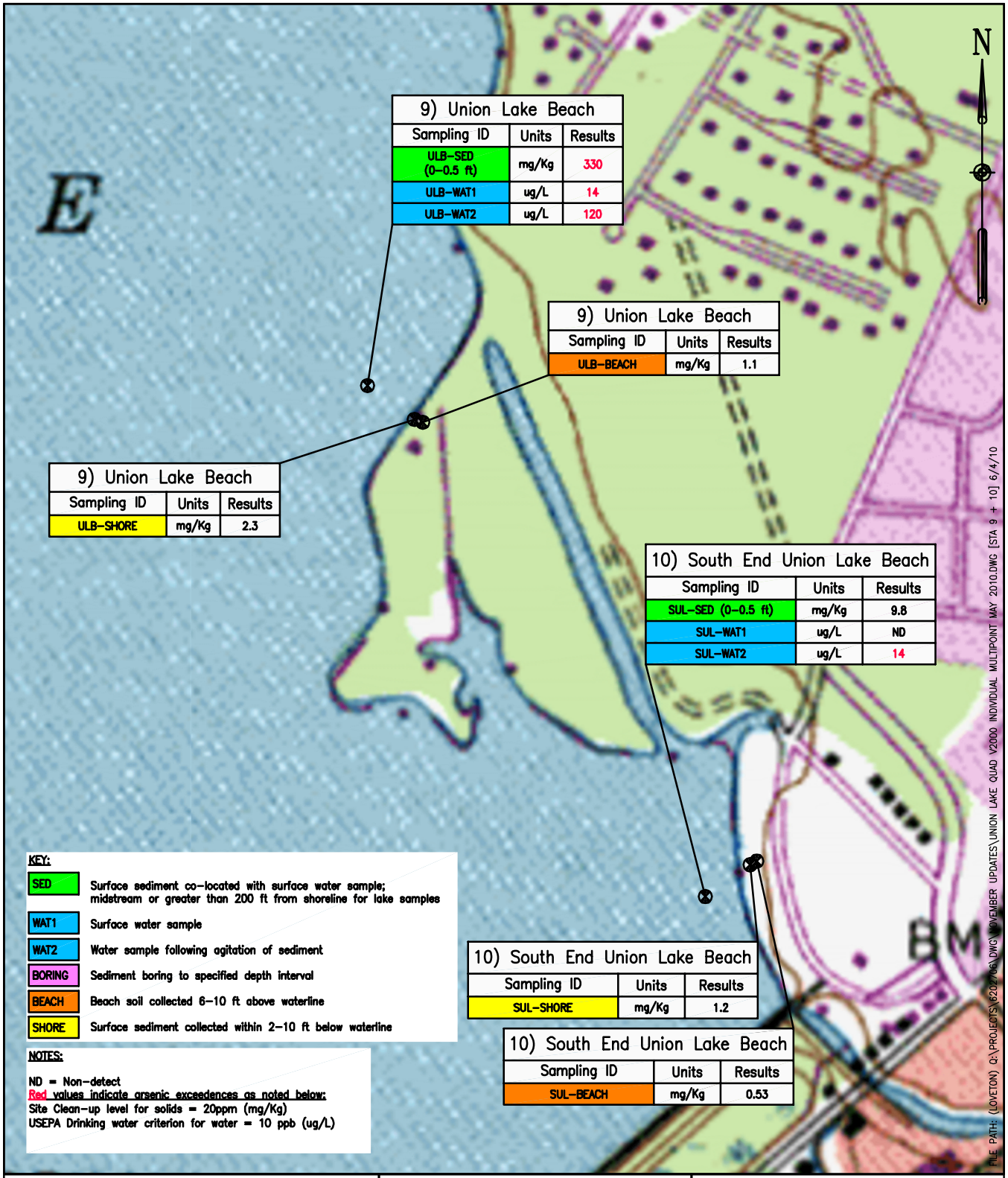

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VINELAND CHEMICAL SUPERFUND SITE
VINELAND, NJ

PERIODIC SAMPLING-SPRING 2010
SAMPLE LOCATIONS
9) UNION LAKE BEACH AND 10)
SOUTH END OF UNION LAKE BEACH

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
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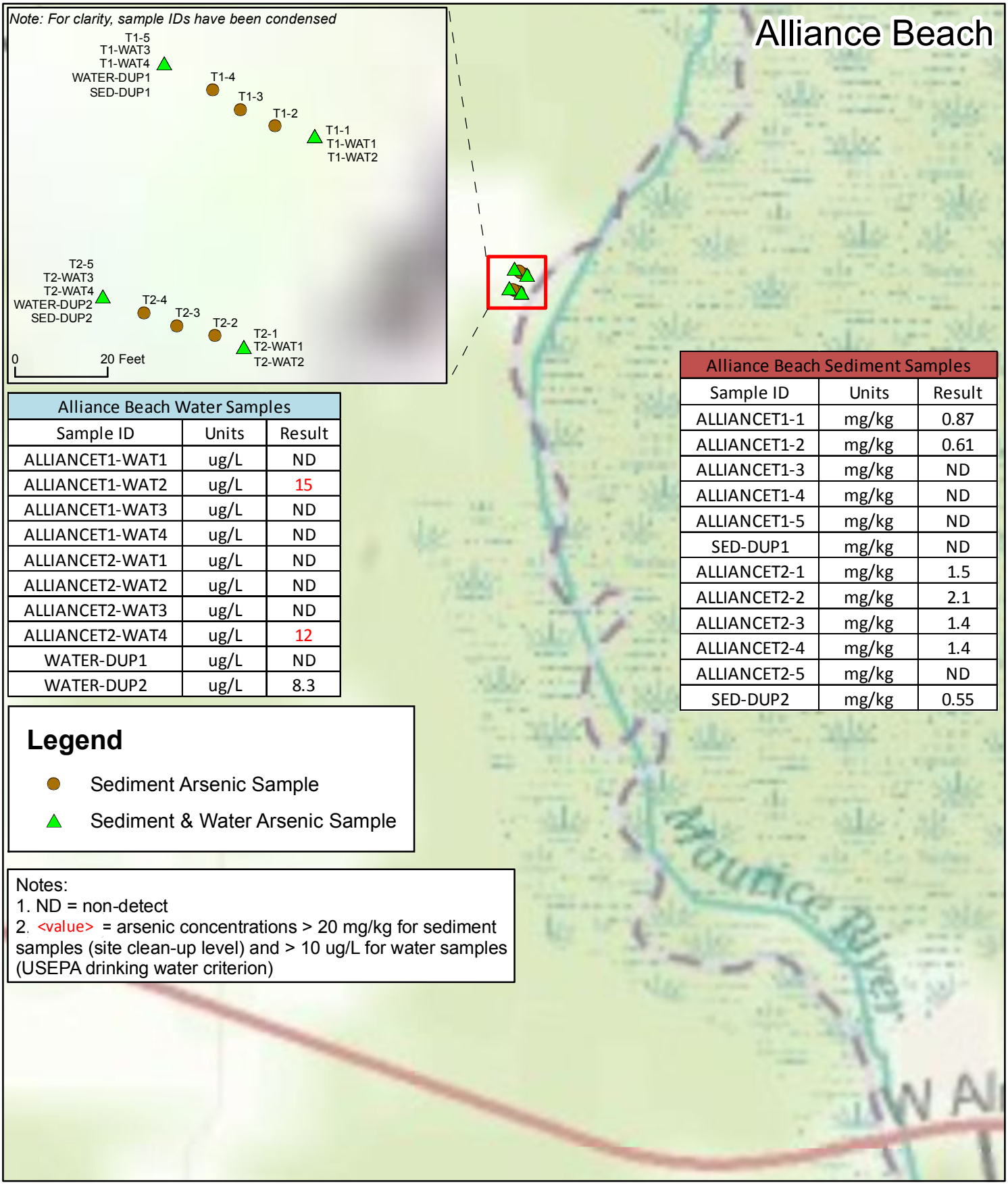

Alliance Beach Water Samples		
Sample ID	Units	Result
ALLIANCET1-WAT1	ug/L	ND
ALLIANCET1-WAT2	ug/L	15
ALLIANCET1-WAT3	ug/L	ND
ALLIANCET1-WAT4	ug/L	ND
ALLIANCET2-WAT1	ug/L	ND
ALLIANCET2-WAT2	ug/L	ND
ALLIANCET2-WAT3	ug/L	ND
ALLIANCET2-WAT4	ug/L	12
WATER-DUP1	ug/L	ND
WATER-DUP2	ug/L	8.3

Alliance Beach Sediment Samples		
Sample ID	Units	Result
ALLIANCET1-1	mg/kg	0.87
ALLIANCET1-2	mg/kg	0.61
ALLIANCET1-3	mg/kg	ND
ALLIANCET1-4	mg/kg	ND
ALLIANCET1-5	mg/kg	ND
SED-DUP1	mg/kg	ND
ALLIANCET2-1	mg/kg	1.5
ALLIANCET2-2	mg/kg	2.1
ALLIANCET2-3	mg/kg	1.4
ALLIANCET2-4	mg/kg	1.4
ALLIANCET2-5	mg/kg	ND
SED-DUP2	mg/kg	0.55

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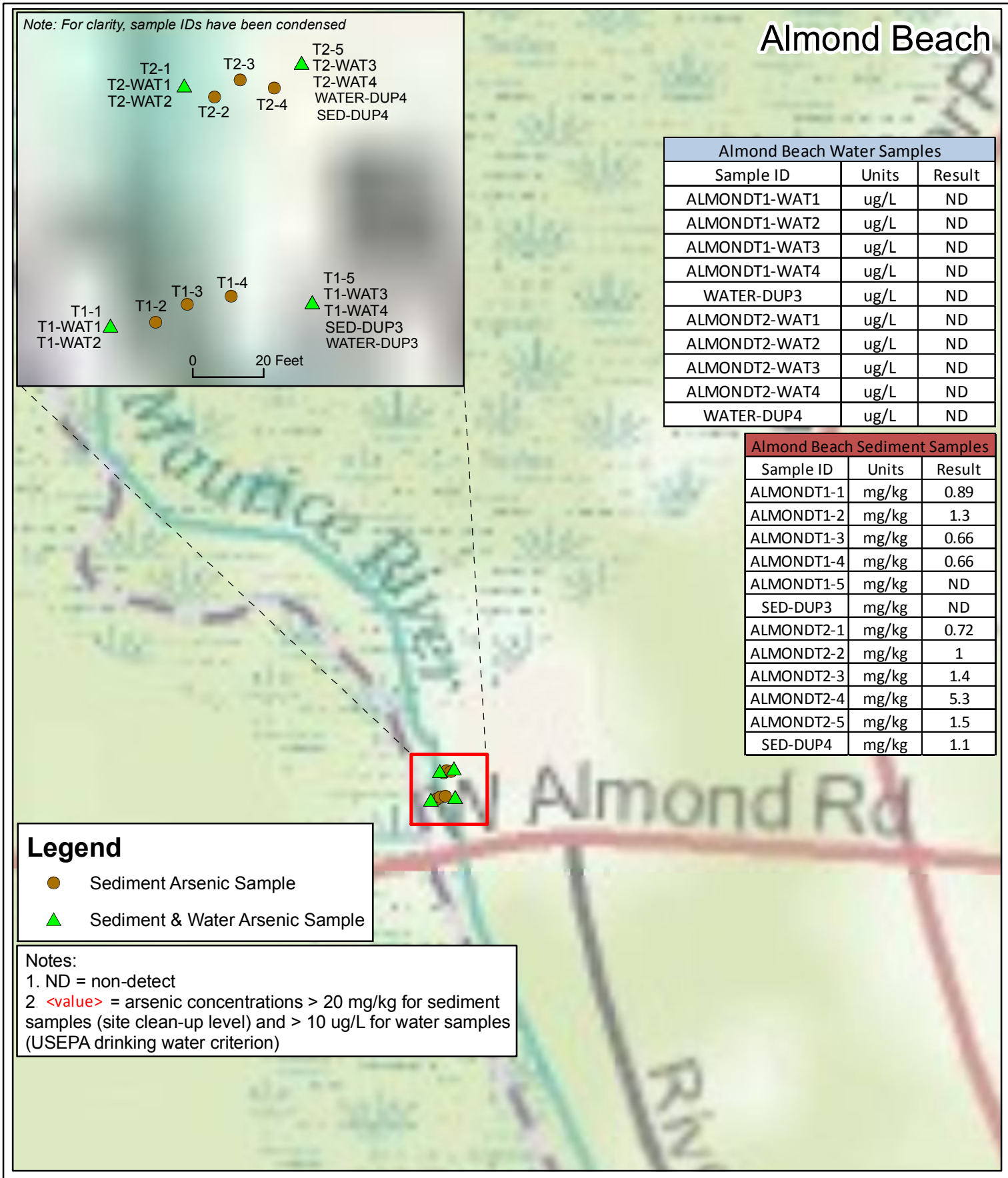
Figure 3-8. Beach Transect Results at Station 4 (Alliance Beach)



Almond Beach Water Samples		
Sample ID	Units	Result
ALMONDT1-WAT1	ug/L	ND
ALMONDT1-WAT2	ug/L	ND
ALMONDT1-WAT3	ug/L	ND
ALMONDT1-WAT4	ug/L	ND
WATER-DUP3	ug/L	ND
ALMONDT2-WAT1	ug/L	ND
ALMONDT2-WAT2	ug/L	ND
ALMONDT2-WAT3	ug/L	ND
ALMONDT2-WAT4	ug/L	ND
WATER-DUP4	ug/L	ND

Almond Beach Sediment Samples		
Sample ID	Units	Result
ALMONDT1-1	mg/kg	0.89
ALMONDT1-2	mg/kg	1.3
ALMONDT1-3	mg/kg	0.66
ALMONDT1-4	mg/kg	0.66
ALMONDT1-5	mg/kg	ND
SED-DUP3	mg/kg	ND
ALMONDT2-1	mg/kg	0.72
ALMONDT2-2	mg/kg	1
ALMONDT2-3	mg/kg	1.4
ALMONDT2-4	mg/kg	5.3
ALMONDT2-5	mg/kg	1.5
SED-DUP4	mg/kg	1.1

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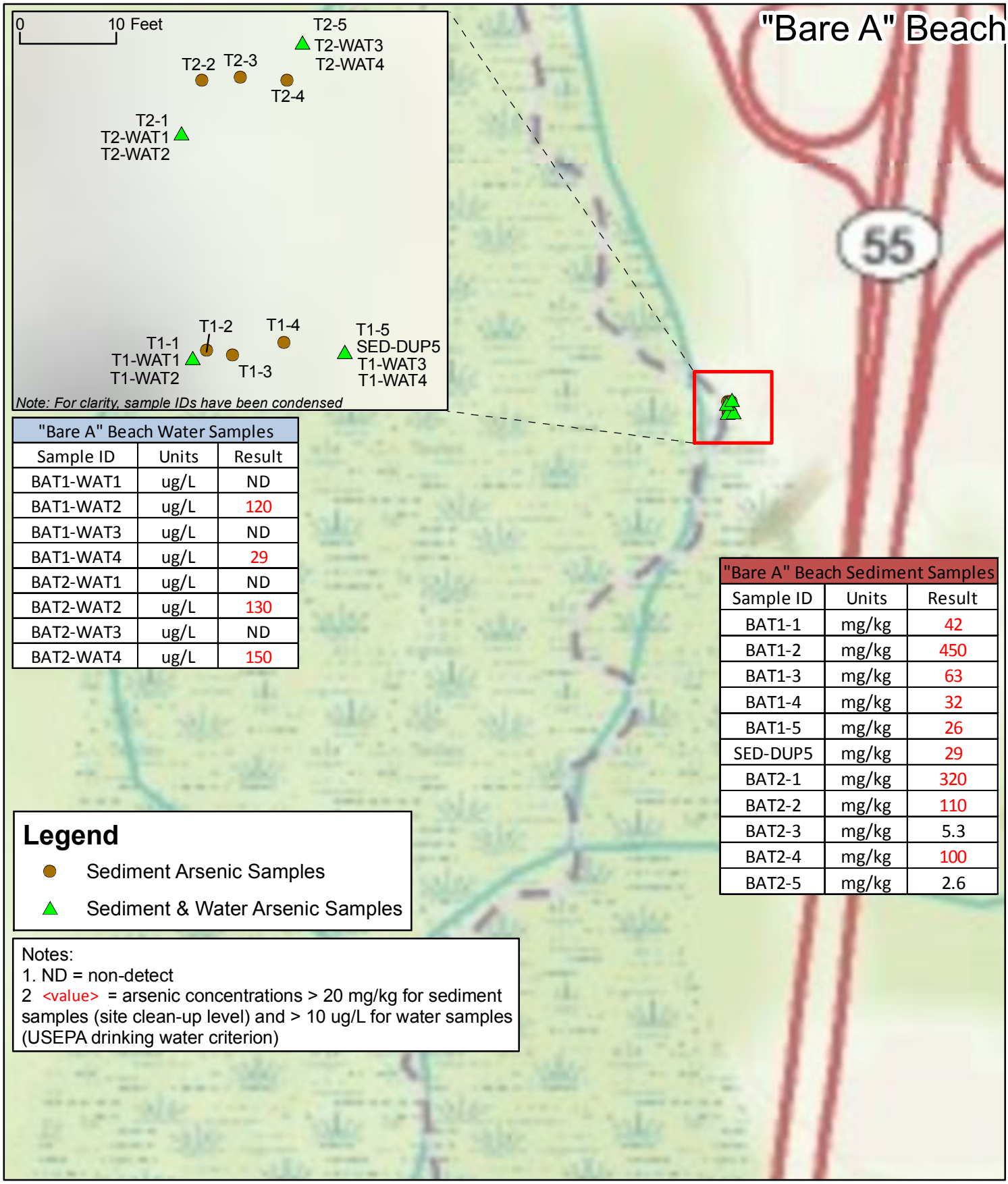
Figure 3-9. Beach Transect Results at Station 5 (Almond Beach)



"Bare A" Beach Water Samples		
Sample ID	Units	Result
BAT1-WAT1	ug/L	ND
BAT1-WAT2	ug/L	120
BAT1-WAT3	ug/L	ND
BAT1-WAT4	ug/L	29
BAT2-WAT1	ug/L	ND
BAT2-WAT2	ug/L	130
BAT2-WAT3	ug/L	ND
BAT2-WAT4	ug/L	150

"Bare A" Beach Sediment Samples		
Sample ID	Units	Result
BAT1-1	mg/kg	42
BAT1-2	mg/kg	450
BAT1-3	mg/kg	63
BAT1-4	mg/kg	32
BAT1-5	mg/kg	26
SED-DUP5	mg/kg	29
BAT2-1	mg/kg	320
BAT2-2	mg/kg	110
BAT2-3	mg/kg	5.3
BAT2-4	mg/kg	100
BAT2-5	mg/kg	2.6

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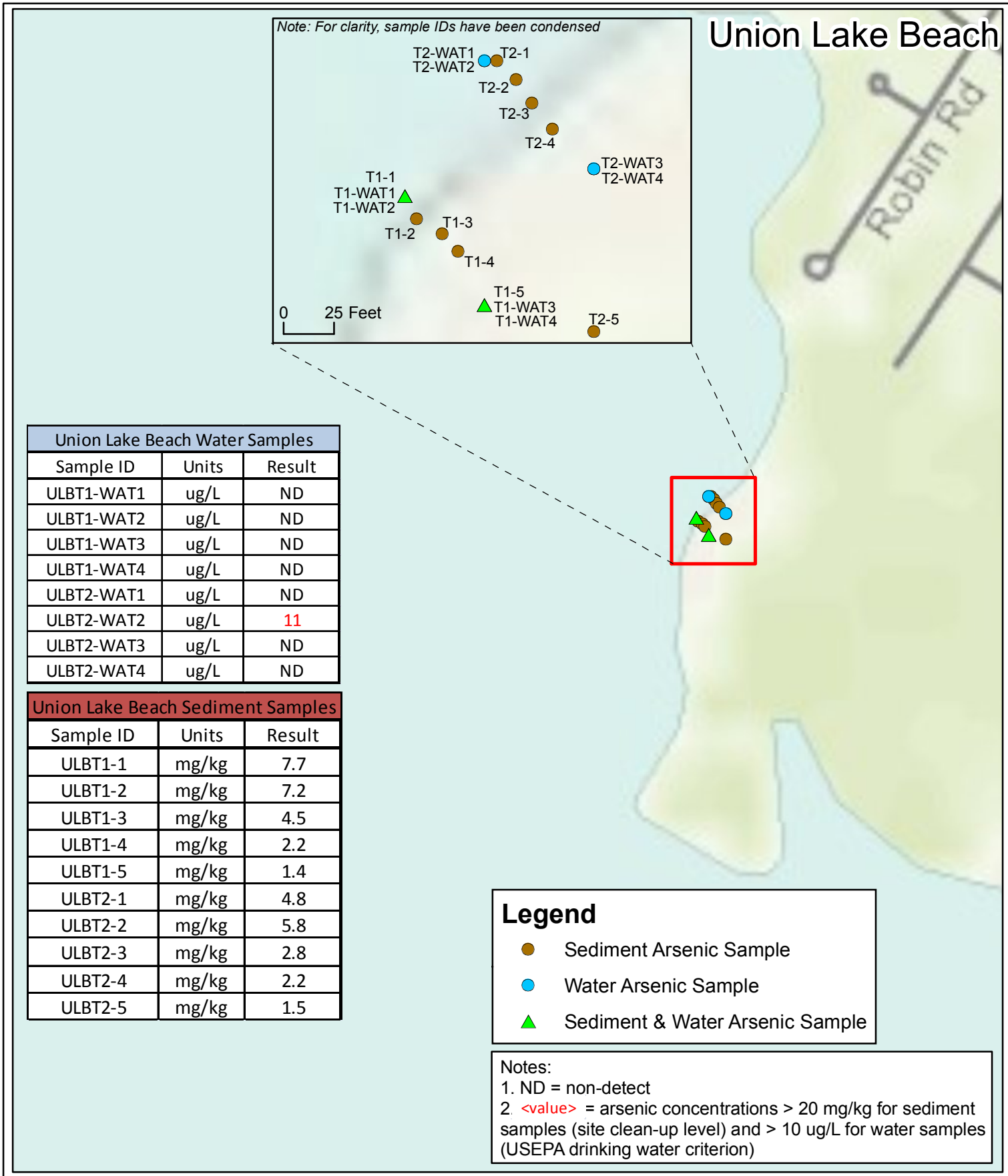
Figure 3-10. Beach Transect Results at Station 6 ("BareA" Beach)



Union Lake Beach Water Samples		
Sample ID	Units	Result
ULBT1-WAT1	ug/L	ND
ULBT1-WAT2	ug/L	ND
ULBT1-WAT3	ug/L	ND
ULBT1-WAT4	ug/L	ND
ULBT2-WAT1	ug/L	ND
ULBT2-WAT2	ug/L	11
ULBT2-WAT3	ug/L	ND
ULBT2-WAT4	ug/L	ND

Union Lake Beach Sediment Samples		
Sample ID	Units	Result
ULBT1-1	mg/kg	7.7
ULBT1-2	mg/kg	7.2
ULBT1-3	mg/kg	4.5
ULBT1-4	mg/kg	2.2
ULBT1-5	mg/kg	1.4
ULBT2-1	mg/kg	4.8
ULBT2-2	mg/kg	5.8
ULBT2-3	mg/kg	2.8
ULBT2-4	mg/kg	2.2
ULBT2-5	mg/kg	1.5

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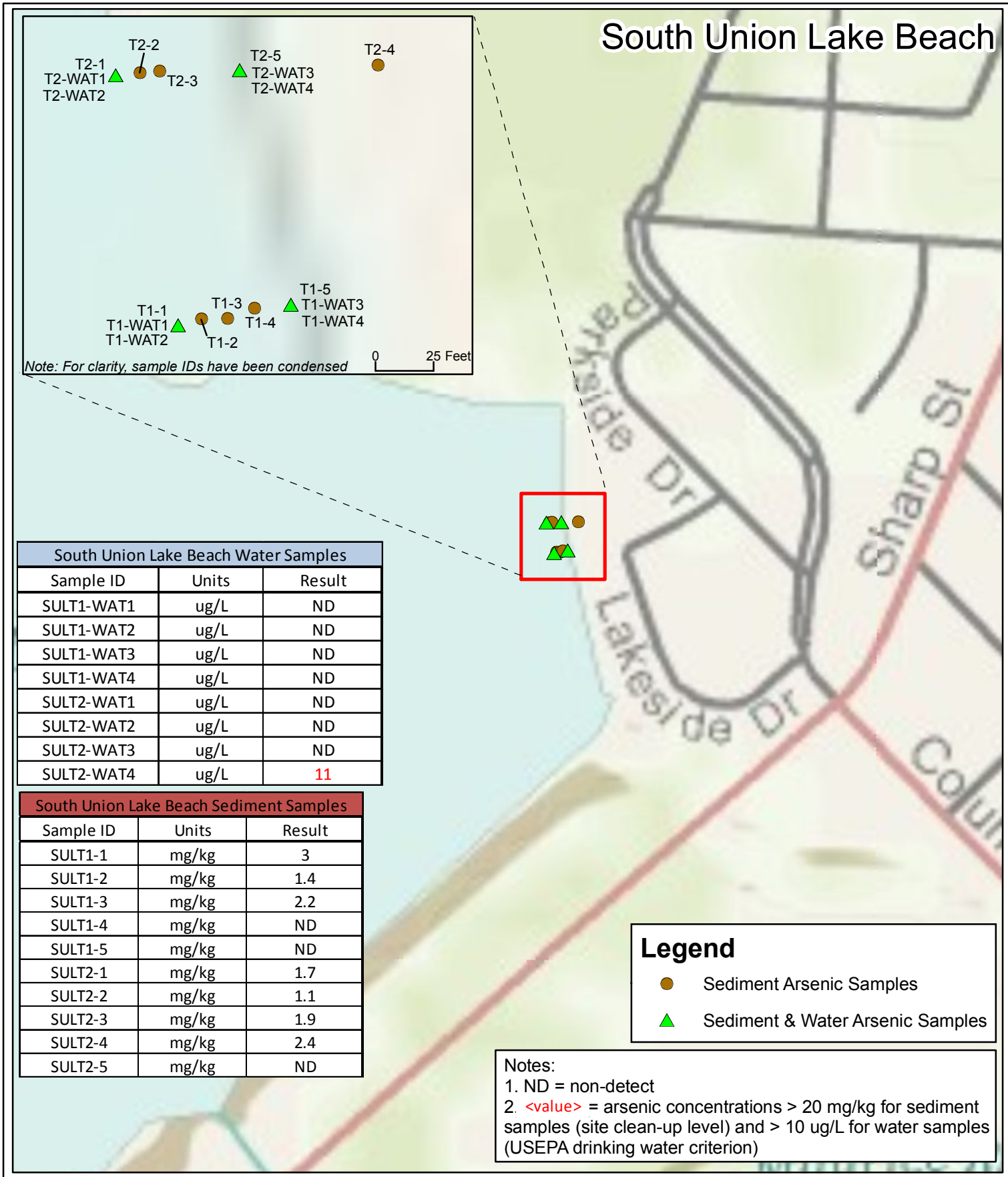
Figure 3-11. Beach Transect Results at Station 9 (Union Lake Beach)

0 200 400 Feet

N W E S



South Union Lake Beach Water Samples		
Sample ID	Units	Result
SULT1-WAT1	ug/L	ND
SULT1-WAT2	ug/L	ND
SULT1-WAT3	ug/L	ND
SULT1-WAT4	ug/L	ND
SULT2-WAT1	ug/L	ND
SULT2-WAT2	ug/L	ND
SULT2-WAT3	ug/L	ND
SULT2-WAT4	ug/L	11

South Union Lake Beach Sediment Samples		
Sample ID	Units	Result
SULT1-1	mg/kg	3
SULT1-2	mg/kg	1.4
SULT1-3	mg/kg	2.2
SULT1-4	mg/kg	ND
SULT1-5	mg/kg	ND
SULT2-1	mg/kg	1.7
SULT2-2	mg/kg	1.1
SULT2-3	mg/kg	1.9
SULT2-4	mg/kg	2.4
SULT2-5	mg/kg	ND

EA Engineering, Science, and Technology, Inc.

Figure 3-12. Beach Transect Results at Station 10 (South End of Union Lake)

0 200 400 Feet

N W E S

TABLE 3-1. ARSENIC CONCENTRATIONS (µg/L) IN WATER SAMPLES COLLECTED IN VICINITY OF VINELAND CHEMICAL SUPERFUND SITE, APRIL/MAY 2010

VINELAND PERIODIC SAMPLING - SPRING 2010

Sample Location	Station ID	Units	Average RL	Result
1) West of Mill Rd	-	-	-	-
2) West of Rte 55	-	-	-	-
3) BWB & Maurice Confluence	BWB-WAT1	ug/L	8	U
	BWB-WAT2	ug/L		**58**
4) Alliance Beach	ALLIANCE-WAT1	ug/L	8	U
	ALLIANCE-WAT2	ug/L	8	U
5) Almond Beach	ALMOND-WAT1	ug/L	8	U
	ALMOND-WAT2	ug/L	8	U
6) "BareA" Beach	BA-WAT1	ug/L		**8.9**
	BA-WAT2	ug/L		**370**
7) Sherman Ave.	SHERMAN-WAT1	ug/L	8	U
	SHERMAN-WAT2	ug/L	8	U
8) North End of Union Lake	NUL-WAT1	ug/L	8	U
	NUL-WAT2	ug/L		**76**
9) Union Lake Beach	ULB-WAT1	ug/L		**14**
	ULB-WAT2	ug/L		**120**
10) South End Union Lake Beach	SUL-WAT1	ug/L	8	U
	SUL-WAT2	ug/L		**14**
Duplicates	DUP-4 (BA-WAT2)	ug/L		**590**
	DUP-5 (ALMOND-WAT2)*	ug/L	8	U
Equipment Blank	PBlank-01	ug/L	8	U
	PBlank-02	ug/L	8	U
	PBlank-03	ug/L	8	U
	TTBlank-01	ug/L	8	U

RL = laboratory reporting limit (average)
NOTE: Bold values represent detected arsenic concentrations; shaded values exceed the USEPA Drinking Water Criterion of 10 ug/L (ppb)
U = arsenic was analyzed, but not detected
*Denotes cross-referenced sample location of blind duplicate sample
"-" = no sample collected

TABLE 3-2. ARSENIC CONCENTRATIONS (mg/Kg) IN SOIL AND SEDIMENT SAMPLES COLLECTED IN VICINITY OF VINELAND CHEMICAL SUPERFUND SITE, APRIL/MAY 2010

VINELAND PERIODIC SAMPLING - SPRING 2010

Sample Location	Station ID	Units	Matrix	Average RL	Result
1) West of Mill Rd	-	-	-	-	-
2) West of Rte 55	-	-	-	-	-
3) BWB & Maurice Confluence	BWB-SED	mg/Kg	Sediment		**3.1**
	BWB-SHORE	mg/Kg	Sediment		**150**
4) Alliance Beach	ALLIANCE-BEACH	mg/Kg	Soil		**0.67**
	ALLIANCE-SED	mg/Kg	Sediment		**2**
	ALLIANCE-SHORE	mg/Kg	Sediment		**0.84**
5) Almond Beach	ALMOND-BEACH	mg/Kg	Soil	0.54	U
	ALMOND-SED	mg/Kg	Sediment		**1.2**
	ALMOND-SHORE	mg/Kg	Sediment	0.46	U
6) "BareA" Beach	BA-BEACH	mg/Kg	Soil	0.57	U
	BA-SED	mg/Kg	Sediment		**120**
	BA-SHORE	mg/Kg	Sediment		**160**
7) Sherman Ave.	SHERMAN-SED	mg/Kg	Sediment		**3.8**
	SHERMAN-SHORE	mg/Kg	Sediment		**3.7**
8) North End of Union Lake	NUL-SED	mg/Kg	Sediment		**410**
	NUL-SHORE	mg/Kg	Sediment		**110**
9) Union Lake Beach	ULB-BEACH	mg/Kg	Soil		**1.1**
	ULB-SED	mg/Kg	Sediment		**330**
	ULB-SHORE	mg/Kg	Sediment		**2.3**
10) South End Union Lake Beach	SUL-BEACH	mg/Kg	Soil		**0.53**
	SUL-SED	mg/Kg	Sediment		**9.8**
	SUL-SHORE	mg/Kg	Sediment		**1.2**
Duplicate	DUP-1 (ALMOND-SHORE)	mg/Kg	Sediment	0.48	U
	DUP-2 (ALMOND-SED)	mg/Kg	Sediment		**1**
	DUP-3 (SUL-BEACH)	mg/Kg	Soil	0.58	U

RL = laboratory reporting limit (average)

NOTE: Bold values represent detected arsenic concentrations; shaded values are equivalent to or exceed the Site Clean-up Level of 20 mg/Kg (ppm)

U = arsenic was analyzed, but not detected

*Denotes cross-referenced sample location of blind duplicate sample

"-" = no sample collected

TABLE 3-3. ARSENIC CONCENTRATIONS (µg/L) IN WATER SAMPLES COLLECTED AT ADDITIONAL BEACH TRANSECTS

VINELAND CHEMICAL SUPERFUND SITE, APRIL 2010

Sample Location	Sample ID	Units	Average RL	Result
4) Alliance Beach	ALLIANCET1-WAT1	ug/L	8	ND
	ALLIANCET1-WAT2	ug/L		**15**
	ALLIANCET1-WAT3	ug/L	8	ND
	ALLIANCET1-WAT4	ug/L	8	ND
	ALLIANCET2-WAT1	ug/L	8	ND
	ALLIANCET2-WAT2	ug/L	8	ND
	ALLIANCET2-WAT3	ug/L	8	ND
	ALLIANCET2-WAT4	ug/L		**12**
5) Almond Beach	ALMONDT1-WAT1	ug/L	8	ND
	ALMONDT1-WAT2	ug/L	8	ND
	ALMONDT1-WAT3	ug/L	8	ND
	ALMONDT1-WAT4	ug/L	8	ND
	ALMONDT2-WAT1	ug/L	8	ND
	ALMONDT2-WAT2	ug/L	8	ND
	ALMONDT2-WAT3	ug/L	8	ND
	ALMONDT2-WAT4	ug/L	8	ND
6) "Bare A" Beach	BAT1-WAT1	ug/L	8	ND
	BAT1-WAT2	ug/L		**120**
	BAT1-WAT3	ug/L	8	ND
	BAT1-WAT4	ug/L		**29**
	BAT2-WAT1	ug/L	8	ND
	BAT2-WAT2	ug/L		**130**
	BAT2-WAT3	ug/L	8	ND
	BAT2-WAT4	ug/L		**150**
9) Union Lake Beach	ULBT1-WAT1	ug/L	8	ND
	ULBT1-WAT2	ug/L	8	ND
	ULBT1-WAT3	ug/L	8	ND
	ULBT1-WAT4	ug/L	8	ND
	ULBT2-WAT1	ug/L	8	ND
	ULBT2-WAT2	ug/L		**11**
	ULBT2-WAT3	ug/L	8	ND
	ULBT2-WAT4	ug/L	8	ND
10) South End Union Lake Beach	SULT1-WAT1	ug/L	8	ND
	SULT1-WAT2	ug/L	8	ND
	SULT1-WAT3	ug/L	8	ND
	SULT1-WAT4	ug/L	8	ND
	SULT2-WAT1	ug/L	8	ND
	SULT2-WAT2	ug/L	8	ND
	SULT2-WAT3	ug/L	8	ND
	SULT2-WAT4	ug/L		**11**
Duplicates	WATER-DUP1 (ALLIANCET1-WAT4)	ug/L	8	ND
	WATER-DUP2 (ALLIANCET2-WAT4)	ug/L		**8.3**
	WATER-DUP3 (ALMONDT1-WAT4)	ug/L	8	ND
	WATER-DUP4 (ALMONDT2-WAT4)	ug/L	8	ND

RL = laboratory reporting limit (average)

NOTE: Bold values represent detected arsenic concentrations; shaded values exceed the USEPA Drinking Water Criterion of 10 ug/L (ppb)

U = arsenic was analyzed, but not detected

*Denotes cross-referenced sample location of blind duplicate sample

TABLE 3-4. ARSENIC CONCENTRATIONS (mg/Kg) IN SEDIMENT SAMPLES COLLECTED AT ADDITIONAL BEACH TRANSECTS
VINELAND CHEMICAL SUPERFUND SITE, APRIL 2010

Sample Location	Sample ID	Units	Average RL	Result
4) Alliance Beach	ALLIANCET1-1	mg/kg		**0.87**
	ALLIANCET1-2	mg/kg		**0.61**
	ALLIANCET1-3	mg/kg	0.47	ND
	ALLIANCET1-4	mg/kg	0.47	ND
	ALLIANCET1-5	mg/kg	0.48	ND
	ALLIANCET2-1	mg/kg		**1.5**
	ALLIANCET2-2	mg/kg		**2.1**
	ALLIANCET2-3	mg/kg		**1.4**
	ALLIANCET2-4	mg/kg		**1.4**
	ALLIANCET2-5	mg/kg	0.51	ND
5) Almond Beach	ALMONDT1-1	mg/kg		**0.89**
	ALMONDT1-2	mg/kg		**1.3**
	ALMONDT1-3	mg/kg		**0.66**
	ALMONDT1-4	mg/kg		**0.66**
	ALMONDT1-5	mg/kg	0.49	ND
	ALMONDT2-1	mg/kg		**0.72**
	ALMONDT2-2	mg/kg		**1**
	ALMONDT2-3	mg/kg		**1.4**
	ALMONDT2-4	mg/kg		**5.3**
	ALMONDT2-5	mg/kg		**1.5**
6) "Bare A" Beach	BAT1-1	mg/kg		**42**
	BAT1-2	mg/kg		**450**
	BAT1-3	mg/kg		**63**
	BAT1-4	mg/kg		**32**
	BAT1-5	mg/kg		**26**
	BAT2-1	mg/kg		**320**
	BAT2-2	mg/kg		**110**
	BAT2-3	mg/kg		**5.3**
	BAT2-4	mg/kg		**100**
	BAT2-5	mg/kg		**2.6**
9) Union Lake Beach	ULBT1-1	mg/kg		**7.7**
	ULBT1-2	mg/kg		**7.2**
	ULBT1-3	mg/kg		**4.5**
	ULBT1-4	mg/kg		**2.2**
	ULBT1-5	mg/kg		**1.4**
	ULBT2-1	mg/kg		**4.8**
	ULBT2-2	mg/kg		**5.8**
	ULBT2-3	mg/kg		**2.8**
	ULBT2-4	mg/kg		**2.2**
	ULBT2-5	mg/kg		**1.5**
10) South End Union Lake Beach	SULT1-1	mg/kg		**3**
	SULT1-2	mg/kg		**1.4**
	SULT1-3	mg/kg		**2.2**
	SULT1-4	mg/kg	0.53	ND
	SULT1-5	mg/kg	0.51	ND
	SULT2-1	mg/kg		**1.7**
	SULT2-2	mg/kg		**1.1**
	SULT2-3	mg/kg		**1.9**
	SULT2-4	mg/kg		**2.4**
	SULT2-5	mg/kg	0.56	ND
Duplicates	SED-DUP1 (ALLIANCET1-5)	mg/kg	0.48	ND
	SED-DUP2 (ALLIANCET2-5)	mg/kg		**0.55**
	SED-DUP3 (ALMONDT1-5)	mg/kg	0.45	ND
	SED-DUP4 (ALMONDT2-5)	mg/kg		**1.1**
	SED-DUP5 (BAT1-5)	mg/kg		**29**

RL = laboratory reporting limit (average)

NOTE: Bold values represent detected arsenic concentrations; shaded values are equivalent to or exceed the Site Clean-up Level of 20 mg/Kg (ppm)

U = arsenic was analyzed, but not detected

*Denotes cross-referenced sample location of blind duplicate sample

"-" = no sample collected

4. SUMMARY AND COMPARISONS OF PERIODIC SAMPLING – SPRING 2010 TO PREVIOUS DATA

Overall, results of the Periodic Sampling – Spring 2010 indicated one more exceedance of the arsenic criterion for agitated surface water samples than for the previous sampling event (Periodic Sampling – Fall 2009). Arsenic concentrations in agitated surface water samples exceeded the 10 µg/L criterion at five of the eight sampling locations. The last sampling event, Periodic Sampling – Fall 2009, had exceedences in agitated surface water samples at four of eight locations. The highest concentration of arsenic in an agitated surface water sample for Spring 2010 was at Station 6 ("Bare A" Beach) with a value of 370 µg/L.

As was noted in Section 1.4, Station 1 (West of Mill Road) and Station 2 (West of Route 55) were not sampled due to remediation activities and stream realignment at these locations. Stations located downstream from Station 2 and upstream of Station 6 ("Bare A" Beach) did not have arsenic concentrations in sediment samples that exceeded the Site Clean-up criterion of 20 ppm. Sediment samples at Station 6, Station 8 (North End of Union Lake), and Station 9 (Union Lake Beach) had arsenic concentrations in sediment samples that exceeded 20 ppm. Arsenic concentrations ranged from 120 mg/Kg at Station 6 to 410 mg/Kg at Station 8. Station 10 (South End of Union Lake) had a detected arsenic concentration of 9.8 mg/Kg but did not exceed the Site Clean-up criterion.

Three of eight locations had arsenic concentrations in shore samples that exceeded the Site Clean-up criterion of 20 ppm. Station 3 (Blackwater Branch confluence) had a concentration of 150 mg/Kg, Station 6 ("Bare A" Beach) had a concentration of 160 mg/Kg, and Station 8 (North End of Union Lake) had a concentration of 110 mg/Kg. The same three stations had exceedances in the Fall 2009 sampling effort. Station 6 had a decrease of arsenic from 280 mg/Kg in Fall 2009 to 160 mg/Kg in Spring 2010. Stations 3 and 8 had increases of arsenic concentrations between Fall 2009 and Spring 2010. Station 3 arsenic concentration increased from 21 mg/Kg in Fall 2009 to 150 mg/Kg in Spring 2010 and Station 8 had an increase from 65 mg/Kg in Fall 2009 to 110 mg/Kg in Spring 2010.

Below Station 2 (West of Rte. 55), additional water flow from the Maurice River and other tributaries flowing into the Maurice River may transport arsenic that is bound to fine particulates further downstream. Previously in the May 2006 and November 2006 Sampling events, arsenic concentrations in sediments, surface water, and beach soil did not exceed criteria at Station 4 (Alliance Beach), Station 5 (Almond Beach), or Station 6 ("BareA" Beach). In September 2007, the first exceedence of applicable criteria occurred at Station 5 (Almond Beach) in the agitated surface water sample and at Station 6 ("BareA" Beach) in both a surface water sample and a nearshore (shore) sediment sample. During sampling in May 2009, the only samples to exceed the Site Clean-up Levels and USEPA Drinking Water Criterion south of Station 2 (West of Route 55) and north of Union Lake were the agitated surface water sample (Wat2) and the shore (sediment) samples at Station 6; the arsenic concentrations were 65 ug/L and 21 mg/Kg, respectively. Sampling in November 2009 had three exceedences of criteria; the agitated surface water sample (Wat2) at Station 7 (Sherman Avenue) and the shore samples at Station 4 and Station 6. For the Periodic Sampling – Spring 2010, five exceedances of arsenic criterion occurred between Station 2 and the north end of Union Lake. Agitated surface water samples at

Station 3 (Blackwater Branch confluence) and Station 6 had arsenic concentrations of 58 µg/L and 370 µg/L, respectively. The sediment sample at Station 6 exceeded the Site Clean-up Level of 20 ppm with an arsenic concentration of 120 mg/Kg. Shore sediment samples at Station 3 and Station 6 also exceeded 20 ppm; Station 3 had an arsenic concentration of 150 mg/Kg and Station 6 had an arsenic concentration of 160 mg/Kg.

Agiated surface water samples, sediment, and shore samples in the Union Lake area had exceedances of their respective criterion. Agiated surface water samples at Station 8 (North End of Union Lake), Station 9 (Union Lake Beach), and Station 10 (South End of Union Lake) had arsenic concentrations of 76 µg/L. 120 µg/L, and 14 µg/L, respectively; the three locations exceeded the criterion of 10 µg/L. Sediment samples at Stations 8 and 9 exceeded the Site Clean-up Level of 10 ppm; Station 8 had an arsenic concentration of 410 mg/Kg and Station 9 had an arsenic concentration of 330 mg/Kg. Station 8 was the only location to exceed 10 ppm for shore samples with an arsenic concentration of 110 mg/Kg.

The overall frequency of arsenic detection and percentage of samples exceeding applicable criteria for the past six sampling events (May 2006 to April 2010) is shown in Table 4-1. The frequency of samples that had arsenic detections remained between 49 % and 65% between May 2006 and April/May 2010. The frequency of arsenic concentrations exceeding applicable criteria ranged from 24% to 40% during this time period; samples obtained during the September 2007 effort had the highest percentage of criteria exceedance with 40%. Non-agitated water samples had relatively low frequencies of arsenic detection (range of 0% to 30%) and samples exceeding the USEPA Drinking Water Criterion of 10 µg/L ranged from 0% to 30% with the only exceedences reported for May 2006 and September 2007 (Table 4-2). Table 4-3 shows that agitated water samples had higher percentages of arsenic frequency detection (range of 30% to 70%) and samples exceeding the USEPA Drinking Water Criterion of 10 µg/L (range of 30% to 70%). Samples from the September 2007 effort had the highest percentage of frequency of arsenic detection and samples exceeding criteria, with values of 70% and 70%, respectively. With the exception of May 2009, all detected concentrations of arsenic in agitated surface water samples exceeded the criterion.

The frequency of arsenic detection in sediment samples ranged from 81% to 94% and the frequency of sample results exceeding the Site Clean-up Level of 20 ppm ranged from 31% to 40% (Table 4-4). The arsenic frequency values stayed relatively consistent between May 2006 and April/May 2010. Table 4-5 presents the frequency of arsenic detection and samples exceeding the Site Clean-up Level of 20 ppm in beach (soil) samples during the same time periods. Frequencies of arsenic detection ranged from 20% to 40%; each sampling effort resulted in 0% of samples exceeding 20 ppm.

4.1 Summary of Periodic Sampling – Spring 2010 Arsenic Results by Station

Station 1 – West of Mill Rd (see Figure 3-1)

Station 1 was not sampled during the Spring 2010 effort due to excavation and remedial activities currently being conducted by USACE-Philadelphia.

Station 2 – West of Rte 55 (see Figure 3-1)
Station 2 was not sampled during the Spring 2010 effort due to excavation and remedial activities currently being conducted by USACE-Philadelphia.

Station 3 – BWB & Maurice Confluence (see Figures 3-1 and 3-2)
Arsenic was detected above the USEPA Drinking Water Criterion of 10 ppb in the agitated water sample at a concentration of 58 µg/L. The shore sediment sample was detected at a concentration of 150 mg/Kg, 7.5 times above the Site Clean-up Level of 20 ppm. Arsenic was detected in the surficial mid-stream sediment sample at 3.1 mg/Kg.

Station 4 – Alliance Beach (see Figures 3-1,3-2, and 3-8)
Arsenic was detected in the surficial mid-stream sediment sample at 2.0 mg/Kg and in the shore sediment sample at 0.84 mg/Kg. Arsenic was not detected in the non-agitated or agitated water samples. In the additional beach transects, none of the arsenic concentrations exceeded the Site Clean-up Level. Two of the agitated water samples exceeded the USEPA Drinking Water Criterion.

Station 5 – Almond Beach (see Figures 3-1, 3-3, and 3-9)
Arsenic was not detected in the surface water, shore, or beach samples. Arsenic was detected in the surficial mid-stream sediment sample at 1.2 mg/Kg. In the additional beach transects, arsenic was not detected in the surface water samples; arsenic detected in the sediment samples was below the Site Clean-up Level of 20 ppm.

Station 6 – "BareA" Beach (see Figures 3-1, 3-4, and 3-10)
Arsenic was detected in the non-agitated water sample (8.9 µg/L) and agitated water sample (370 µg/L); the agitated water sample exceeded the USEPA Drinking Water Criterion of 10 ppb by a factor of 37. The sediment sample exceeded the Site-Clean up Level of 20 ppm by a factor of 6 with an arsenic concentration of 120 mg/Kg. The shore sample had an arsenic concentration of 160 mg/Kg exceeding the 20 ppm criterion by a factor of 8. Arsenic was not detected in the beach sample. The additional beach transect results had 8 of 10 sediment samples exceeding the Site Clean-up Level. Four agitated water samples at the additional beach transects exceeded the USEPA Drinking Water Criterion.

Station 7 – Sherman Ave. (see Figures 3-1 and 3-5)
Arsenic was not detected in the non-agitated or agitated surface water samples. Arsenic was detected in the sediment sample (3.8 mg/Kg) and shore sample (3.7 mg/Kg); both were below the Site Clean-up Level of 20 ppm.

Station 8 – North End of Union Lake (see Figures 3-1 and 3-6)
The agitated water sample exceeded the criterion of 10 ppb by a factor of 7.6 with an arsenic concentration of 76 µg/L. Arsenic was detected in both the sediment sample (410 mg/Kg) and shore sample (110 mg/Kg). The samples exceeded the Site Clean-up Level of 20 ppm by factors of 20.5 and 5.5, respectively.

Station 9 – Union Lake Beach (see Figures 3-1, 3-7, and 3-11)
The non-agitated surface water sample exceeded the criterion of 10 ppb by a factor of 1.4 with a concentration of 14 µg/L. The agitated water sample also exceeded the criterion of 10 ppb by a factor of 12 with an arsenic concentration of 120 µg/L. Arsenic was detected in the sediment sample at a concentration of 330 mg/Kg exceeding the 20 ppm criterion by a factor of 16.5. Arsenic was detected below the 20 ppm criterion in the shore sample with a concentration of 2.3 mg/kg and in the beach sample with a concentration of 1.1 mg/Kg. In additional beach transects, arsenic was detected in all of the sediment samples but at concentrations lower than the Site Clean-up Level of 10 ppm. One agitated water sample, ULBT2-WAT2, exceeded the criterion of 10 ppb by a factor of 1.1 with an arsenic concentration of 11 µg/L.

Station 10 – South End of Union Lake Beach (see Figures 3-1, 3-7 and 3-12)
Arsenic was detected in the agitated water sample at a concentration of 14 ug/L; this exceeded the Drinking Water Criteria by a factor of 1.4. The sediment sample had an arsenic concentration of 9.8 mg/Kg and in the shore sample at a concentration of 1 mg/Kg; both samples were below the Site Clean-up Level of 20 ppm. Arsenic was not detected in the beach sample at this location. In additional beach transects, arsenic detected in sediment samples was below the criterion of 20 ppm. One agitated water sample, SULT2-WAT4, exceeded the criterion of 10 ppb by a factor of 1.1 with an arsenic concentration of 11 µg/L.

4.2 Comparison of April 2010 Arsenic Results to November 2009, May 2009, September 2007, November 2006, and May 2006 Arsenic Results

The current phase of remediation at the site involves removing the contaminated soils/sediments of the Blackwater Branch and the floodplain from Mill Road to the Maurice River Parkway (west of Route 55). The baseline sampling conducted in May 2006 and the November 2006 Periodic Sampling was conducted during the excavation/construction activities. Sampling in September 2007 occurred during remediation of the Blackwater Branch and floodplain east of Mill Road and adjacent to the Vineland Chemical Superfund site. Sampling in May 2009 occurred during remediation of the Blackwater Branch west of Mill Road to Route 55. During sampling in November 2009, remediation activities had extended from west of Mill Road to west of Route 55 down to the Maurice River Parkway. The results from the previous sampling events are compared to the results from the Periodic Sampling – Spring 2010 (April 2010).

In the May 2006 Baseline Sampling, the November 2006 Periodic Sampling, and the September 2007 Post Remedial Action Sampling, arsenic concentrations were analyzed in sediments, soil, and surface water collected at the same ten locations in and near waterways located adjacent to the site. Both the May 2006 Baseline Sampling and the September 2007 Post Remedial Action Sampling included the collection and analysis of deep sediment cores; the November 2006 Periodic Sampling effort did not include the collection and analysis of deep sediment cores. With the exception of core sampling and analysis and the exclusion of Station 1 (West of Mill Road) and Station 2 (West of Route 55), the sampling scheme and sampling locations for the May 2006 Baseline Sampling, the November 2006 Periodic Sampling, the September 2007 Post Remedial Action Sampling, the Periodic Sampling – Spring 2009, the Periodic Sampling – Fall 2009, and the Periodic Sampling – Spring 2010 were identical. The following paragraphs and Table 4-6 compare the results of the May 2006 Baseline Sampling, the November 2006 Periodic

Sampling, the September 2007 Post Remedial Action Sampling, the Periodic Sampling – Spring 2009, the Periodic Sampling – Fall 2009, and the Periodic Sampling – Spring 2010 for sediment, soil, and surface water samples.

May and November 2006, September 2007, May and November 2009, and April/May 2010 Arsenic Surface Water Data

The May 2006 results indicated that five of 20 surface water samples exceeded the applicable criteria, the November 2006 results indicated that only three of 20 surface water samples exceeded the applicable criterion, and the September 2007 results indicated that ten of 20 surface water samples exceeded the applicable criterion. Results of the May 2009 sampling showed that three of 18 surface water samples exceeded the USEPA Drinking Water Criterion of 10µg/L. November 2009 results showed that four of 16 samples exceeded the USEPA Drinking Water Criterion. Four of the 10 surface water samples exceeded the Drinking Water Criterion in the April 2010 sampling. Surface water arsenic concentrations that were equivalent to or exceeded the USEPA Drinking Water Criterion of 10 µg/L ranged from 10 to 1,900 µg/L for the May 2006 sampling, from 11 to 900 µg/L for the November 2006 sampling, from 12 to 3,800 µg/L for the September 2007 sampling, and from 65 to 12,000 µg/L for the May 2009 sampling. In November 2009, the concentrations that were equivalent to or exceeded the 10 µg/L criterion ranged from 19 to 1,100 µg/L. Surface water samples that exceeded the criterion in April/May 2010 ranged from 14 to 370 µg/L.

Data for each of the six sampling events indicated that the stations with the highest arsenic concentrations were located directly downstream of the site – Station 1 (West of Mill Rd.) and Station 2 (West of Rte. 55). Generally, for the November 2006 Periodic Sampling and May 2009 sampling, only the agitated surface water samples (versus pre-agitated surface water samples) exceeded the USEPA Drinking Water Criterion of 10 µg/L (ppb). In September 2007, there were substantially more exceedences of arsenic in the agitated surface water samples at the majority of the stations. First-time exceedences of the USEPA Drinking Water Criterion for arsenic in surface water occurred at Station 5 (Almond Beach), Station 8 (North End of Union Lake), and Station 9 (Union Lake Beach) in September 2007. In May 2009 and November 2009, agitated surface water sampled at locations 2, 7 (Sherman Avenue), 8, 9, and 10 exceeded the USEPA Drinking Water Criterion. In April/May 2010, five of eight agitated surface water samples exceeded the USEPA Drinking Water Criterion. At Station 9, the pre-agitated surface water sample exceeded the criterion with an arsenic concentration of 14 µg/L.

May and November 2006, September 2007, May and November 2009, and April/May 2010 Arsenic Mid-Stream Sediment (0-0.5ft) Data

The May 2006 results indicated that four of 10 sediment samples exceeded the applicable criterion of 20 ppm, the November 2006 results indicated that five of 10 sediment samples exceeded the applicable criterion, and the September 2007 results indicated that four of 10 sediment samples exceeded the applicable criterion. In May 2009, four of 9 sediment samples exceeded the applicable criterion. Two of eight samples exceeded the applicable criterion in November 2009. Samples collected in April/May 2010 had three of 8 samples that exceeded the applicable criterion.

Arsenic concentrations that exceeded the Site Clean-up Level of 20 ppm ranged from 160 to 1,500 mg/Kg for the May 2006 results, from 20 to 2,100 mg/Kg for the November 2006 results, from 30 to 1,700 mg/Kg for the September 2007 results, and from 28 to 340 mg/Kg for the May 2009 results. The arsenic concentrations that exceeded the applicable criterion in November 2009 were 330 mg/Kg at Station 9 (Union Lake Beach) and 40 mg/Kg at Station 10 (South End of Union Lake). For the April/May 2010 sampling effort, Station 6 ("Bare A" Beach) had an arsenic concentration of 120 mg/Kg, Station 8 (North End of Union Lake) had a concentration of 410 mg/Kg, and Station 9 had an arsenic concentration of 330 mg/Kg.

May and November 2006, September 2007, May and November 2009, and April/May 2010 Arsenic Nearshore (Shore) Sediment (0-0.5ft) Data

Shore stations from Station 1 (West of Mill Rd.), Station 2 (West of Rte. 55), and Station 8 (North End of Union Lake) exceeded the Site Clean-up Level of 20 ppm for the May 2006, November 2006, and September 2007 sampling events. For the May 2009 sampling, Station 2 and Station 8 exceeded the applicable criterion. In September 2007 and May 2009, the shore sample for Station 6 ("BareA" Beach) also exceeded the criterion. Results from the November 2009 sampling show that Station 3(Blackwater Branch confluence), Station 6 ("BareA" Beach), and Station 8 (North End of Union Lake) exceeded the criterion. In April/May 2010 three of eight locations had shore samples that exceeded the criterion; Station 3 (Blackwater Branch confluence), Station 6, and Sation 8 (North End of Union Lake).

Arsenic concentrations in the shore sediments that exceeded the Site Clean-up Level of 20 mg/Kg (ppm) ranged from 88 to 1,200 mg/Kg, 140 to 4,500 mg/Kg, and 110 to 3,400 mg/Kg for the May 2006, November 2006, and September 2007 events, respectively. The range for May 2009 was 21 to 2,100 mg/Kg and the range for November 2009 was 21 to 280 mg/Kg. April/May 2010 arsenic shore concentrations that exceeded the criterion ranged from 110 to 160 mg/Kg.

May and November 2006, September 2007, May and November 2009, and April/May 2010 Arsenic Beach Soil (0-0.5ft) Data

Detected concentrations between May 2006 and April/May 2010 were either comparable to or lower than those previously reported for each of the five beach stations. None of the 2006, 2007, 2009, and 2010 beach samples exceeded the Site Clean-up Level of 20 mg/kg for arsenic in soil.

4.3 Comparison of Periodic Sampling – Spring 2010 Arsenic Results to Historical Data

During 1992 and from 1994 through 1999, surface water, soil, and sediment samples were collected in the vicinity of and downstream of the Vineland site at beach stations for arsenic analyses (USEPA/ERTC 1999). These data were collected to evaluate the results against human health risk-base action levels and were part of an annual monitoring program performed at beaches along the Maurice River and Union Lake (USEPA/ERTC 1999). Data were collected from five beach locations including Alliance Beach (Station 4), Almond Beach (Station 5), "BareA" Beach (Station 6), Union Lake Beach (Station 9), and South End Union Lake Beach (Station 10). Each of the matrices (surface water, soil, and sediment) was not collected at each station every year. From 1992 and 1994 through 1999, no discernable trends in the historical arsenic data were evident; the concentration of arsenic in each matrix appeared to remain

relatively constant over time (USEPA/ERTC 1999). The 1999 report that contains historical arsenic data for the 1992 and 1994 through 1999 is provided in Appendix C. These data were compared to data from the 2006, 2007, 2009, and 2010 sampling events.

The historical arsenic data for the five stations (listed above) were compared to the May 2006 Baseline Sampling, the November 2006 Periodic Sampling, the September 2007 Post Remedial Action Sampling, the Periodic Sampling – Spring 2009, the Periodic Sampling – Fall 2009, and the Periodic Sampling – Spring 2010 for surface water, beach soils, and surficial sediment arsenic concentrations (Tables 4-7 through 4-9 and Figures 4-1 through 4-3, respectively). The following paragraphs compare the historical arsenic data (1992 and 1994 through 1999) to the data collected in May 2006, November 2006, September 2007, May 2009, November 2009, and April 2010 by matrix (surface water, soil, and sediment) and by station. Five of the ten total stations that were sampled in the May and November 2006, September 2007, May 2009, November 2009, and April 2010 sampling surveys were also sampled in 1992 and 1994 through 1999; the five stations included in the 2006, 2007, 2009, and 2010 surveys that were not previously sampled (Stations 1, 2, 3, 7, and 8) are not included in this discussion.

Comparisons to Historical Arsenic Surface Water Data (1992, 1994 through 1999, 2006, 2007, 2009, and 2010)

Surface water data from non-agitated samples collected between May 2006 and April 2010 indicated that arsenic was detected above the criterion at Station 6 in September 2007 (13 µg/L) and at Station 9 in November 2009 (10 µg/L) and April 2010 (14 µg/L) (Table 4-7 and Figure 4-1). The overall trend shows a decrease in arsenic concentrations with episodic spikes in arsenic concentrations at Bare "A" Beach and Union Lake Beach in November 2009 and April 2010.

Table 4-7 and Figure 4-2 show the trend in agitated surface water sample results from 1992 to April 2010. Throughout the period of 1992 and 1994-1999, arsenic concentrations in agitated surface waters at Station 4 (Alliance Beach), Station 5 (Almond Beach), and Station 6 ("BareA" Beach) were variable and substantially exceeded the current USEPA Drinking Water Criterion of 10 µg/L. Arsenic concentrations in surface waters at Station 9 (Union Lake Beach) slightly declined from 1996 (above criterion) through 1999 (below criterion). The arsenic concentration in surface water at Station 10 (South End of Union Lake Beach) was above the criterion in both 1998 and 1999. Post-1999 there was very little increase in arsenic concentrations except for three spikes in the results. Station 10 (South End of Union Lake Beach) had an agitated surface water sample arsenic concentration of 550 µg/L in May 2009; Station 9 (Union Lake Beach) had an arsenic concentration of 1,100 µg/L in November 2009 and 120 µg/L in April 2010; and Station 6 (Bare "A" Beach) had an arsenic concentration of 370 µg/L in April 2010. The agitated surface water sample results do not suggest any significant trends in arsenic concentrations for any single location.

Comparisons to Historical Beach Soil Data (1992, 1994 through 1999, 2006, 2007, and 2010)

None of the beach soil samples collected in 1992, 1994 through 1999, and 2006 exceeded the Site Clean-up Level of 20 ppm for arsenic at Station 4 (Alliance Beach), Station 5 (Almond Beach), Station 6 ("BareA" Beach), Station 9 (Union Lake Beach), and Station 10 (South End of Union Lake Beach). Detected concentrations in May 2006, November 2006, September 2007, May 2009, November 2009, and April 2010 were either comparable to or lower than those

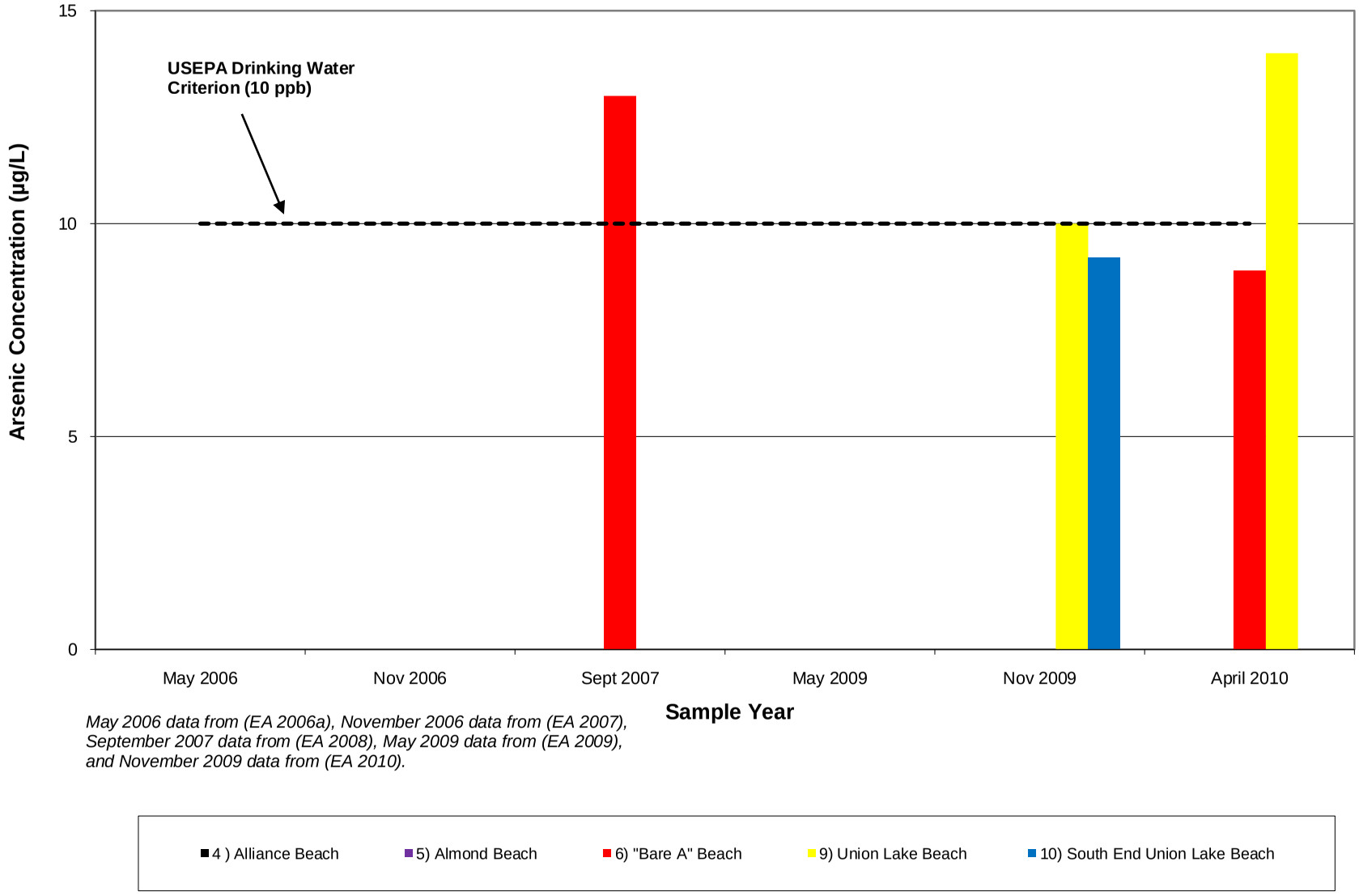
May 2009, November 2009, and April 2010 were either comparable to or lower than those previously reported for each of the five stations. None of the 2006, 2007, 2009, and 2010 samples exceeded the Site Clean-up Level of 20 ppm. Table 4-8 and Figure 4-3 present the comparisons of beach soil data results from 1992 to November 2009. The overall trend of arsenic concentrations for beach soils shows a consistent level of arsenic below 5 mg/kg for the past 18 years of sampling efforts.

Comparisons to Historical Surface Sediment Data (1992, 1994 through 1999, 2006, 2007, 2009, and 2010)

Throughout the period of 1992 and 1994-1999, arsenic concentrations were below the Site Clean-up Level of 20 ppm at each of the five stations, with the exception of Station 6 ("BareA" Beach) in 1998. Results from samples collected between May 2006 and November 2009 indicated that arsenic concentrations in surficial sediment (collected greater than 200 ft from the shoreline) at Station 9 (Union Lake Beach) and Station 10 (South End of Union Lake Beach) were substantially higher than concentrations previously reported in 1992 and 1994-1999. The data from May 2006 to May 2009 show a slight decrease in arsenic concentrations for each successive sampling event. Results from November 2009 indicate an increase in arsenic concentration at Station 9 and Station 10 compared to May 2009 results. Surface sediment collected in April 2010 showed an increase in arsenic concentrations at Station 6 ("Bare A" Beach) compared to November 2009 results. Arsenic concentrations in surficial sediment at Station 9 were equivalent to results in November 2009. Table 4-9 and Figure 4-4 show the comparisons of surficial sediment data results from 1992 to November 2009.

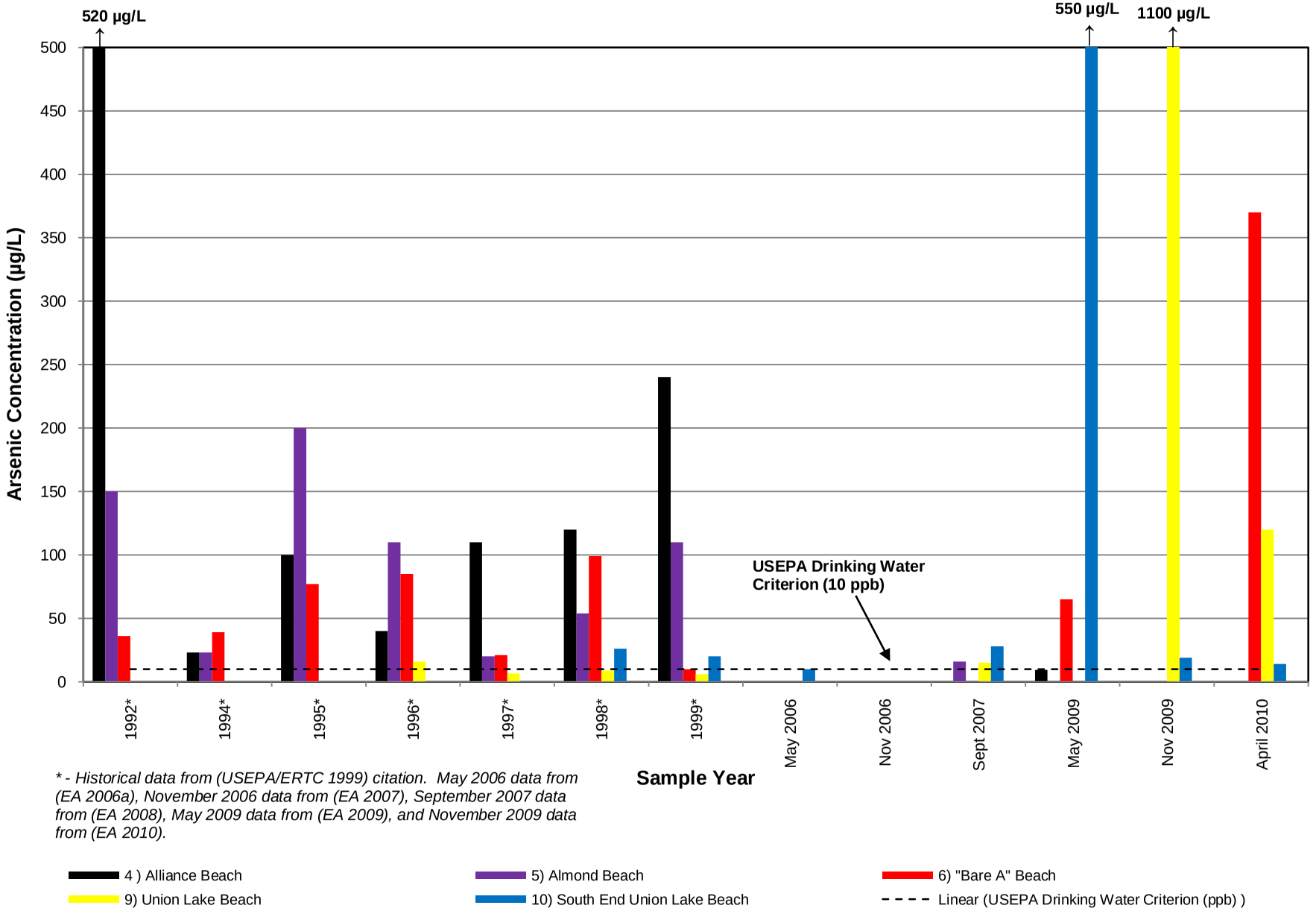
The data for surface sediment data from 1992 through 2010 shows two sample sets with concentrations of arsenic exceeding the Clean-up Level of 20 ppm. Station 6 (Bare "A" Beach) shore sediments had high concentrations in September 2007, November 2009, and April 2010. Station 9 (Union Lake Beach) surficial sediments exceeded the Clean-up Level every sampling effort between May 2006 and April 2010. These results suggest possible areas of deposition that have led to the numerous instances of exceedances when compared to the other sampling locations.

Figure 4-1. Arsenic Concentrations (µg/L) in Non-Agitated Water Collected in the Vicinity of Vineland Chemical Superfund Site, 2006-2010



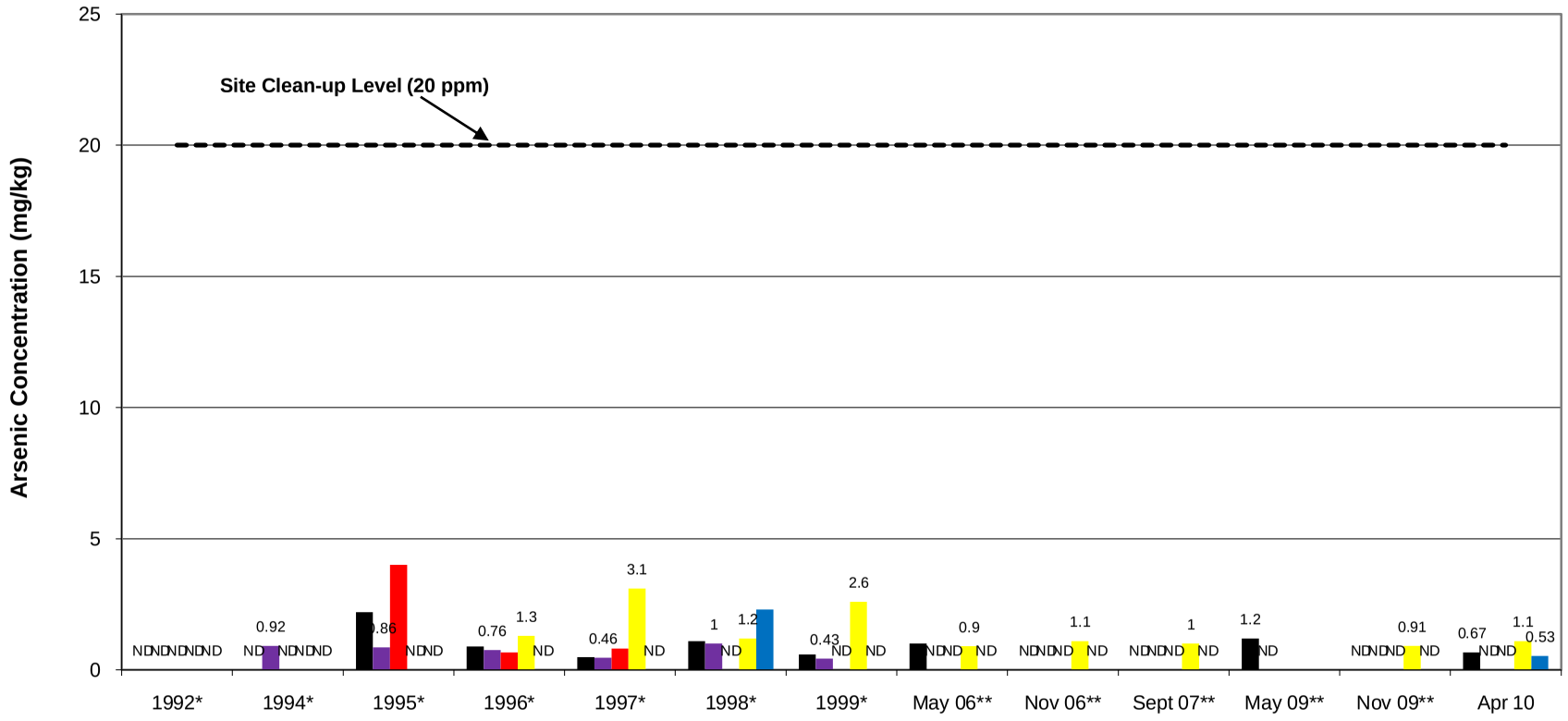
May 2006 data from (EA 2006a), November 2006 data from (EA 2007), September 2007 data from (EA 2008), May 2009 data from (EA 2009), and November 2009 data from (EA 2010).

Figure 4-2. Arsenic Concentrations (µg/L) in Agitated Water Collected in the Vicinity of Vineland Chemical Superfund Site, 1992 - 2010



** - Historical data from (USEPA/ERTC 1999) citation. May 2006 data from (EA 2006a), November 2006 data from (EA 2007), September 2007 data from (EA 2008), May 2009 data from (EA 2009), and November 2009 data from (EA 2010).*

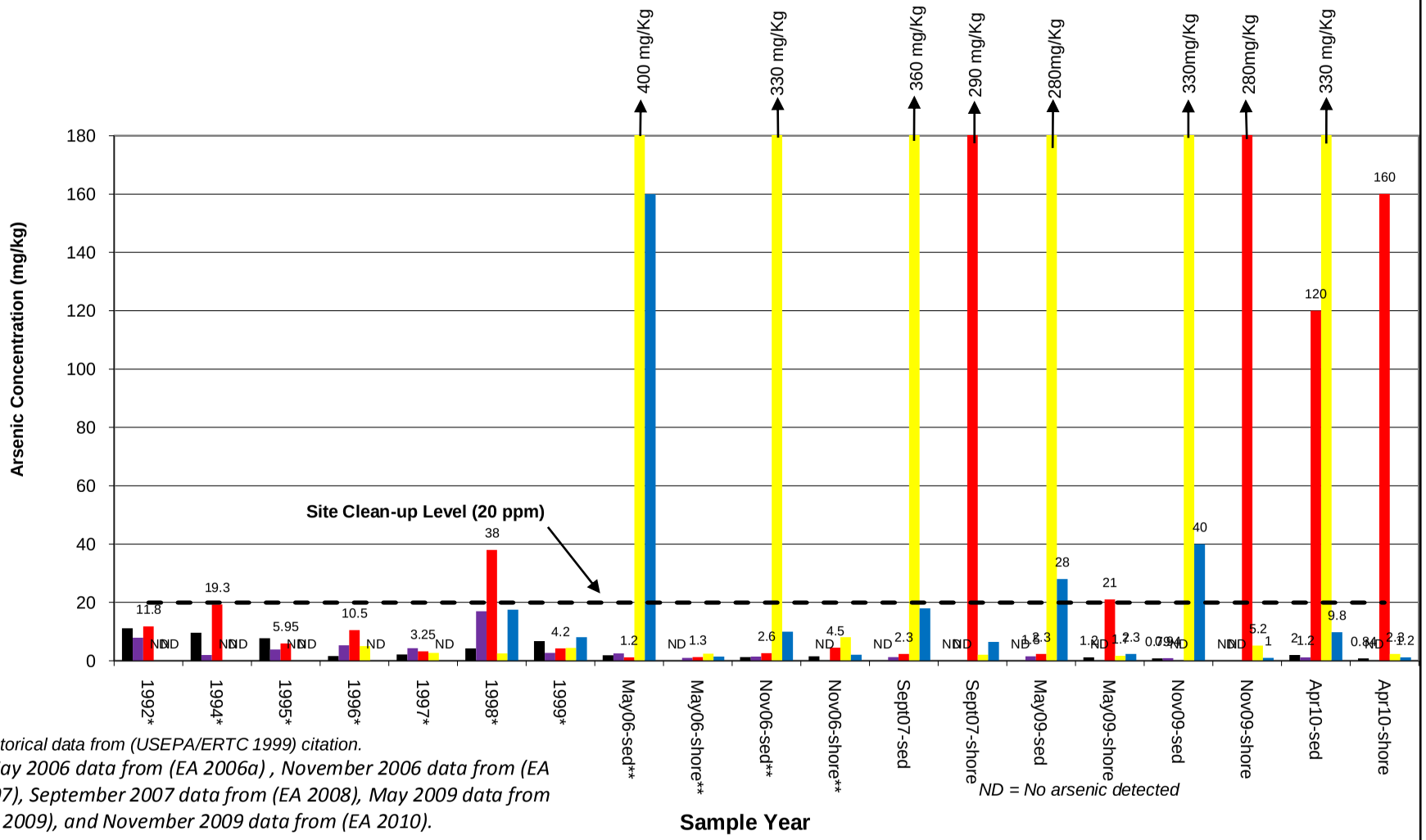
Figure 4-3. Arsenic Concentrations (mg/Kg) in Beach (Soil) Samples Collected in the Vicinity of Vineland Chemical Superfund Site, 1992-2010



**Historical data from (USEPA/ERTC 1999) citation.*

***May 2006 data from (EA 2006a) , November 2006 data from (EA 2007), September 2007 data from (EA 2008), May 2009 data from (EA 2009), and November 2009 data from*

Figure 4-4. Arsenic Concentrations (mg/Kg) in Surficial Sediment Samples Collected in the Vicinity of Vineland Chemical Superfund Site, 1992-2010



**Historical data from (USEPA/ERTC 1999) citation.*

***May 2006 data from (EA 2006a) , November 2006 data from (EA 2007), September 2007 data from (EA 2008), May 2009 data from (EA 2009), and November 2009 data from (EA 2010).*

TABLE 4-1. FREQUENCY OF ARSENIC DETECTION AND EXCEEDENCES IN ALL SAMPLES COLLECTED BETWEEN MAY 2006 AND SPRING 2010

VINELAND PERIODIC SAMPLING - SPRING 2010

Sampling Event	Frequency of Arsenic Detection in Samples (%)	Samples Exceeding Applicable Criteria (%)
May 2006	56	27
November 2006	51	24
September 2007	62	40
May 2009	49	24
November 2009	54	24
April / May 2010	65	30

TABLE 4-2. FREQUENCY OF ARSENIC DETECTION AND EXCEEDENCES IN NON-AGITATED WATER SAMPLES COLLECTED BETWEEN MAY 2006 AND SPRING 2010

VINELAND PERIODIC SAMPLING - SPRING 2010

Sampling Event	Frequency of Arsenic Detection in Samples (%)	Samples Exceeding Applicable Criteria (%)
May 2006	20	20
November 2006	10	0
September 2007	30	30
May 2009	0	0
November 2009	25	0
April / May 2010	25	0

TABLE 4-3. FREQUENCY OF ARSENIC DETECTION AND EXCEEDENCES IN AGITATED WATER SAMPLES COLLECTED BETWEEN MAY 2006 AND SPRING 2010

VINELAND PERIODIC SAMPLING - SPRING 2010

Sampling Event	Frequency of Arsenic Detection in Samples (%)	Samples Exceeding Applicable Criteria (%)
May 2006	30	30
November 2006	30	30
September 2007	70	70
May 2009	44	33
November 2009	50	50
April / May 2010	50	50

TABLE 4-4. FREQUENCY OF ARSENIC DETECTION AND EXCEEDENCES IN SEDIMENT SAMPLES COLLECTED BETWEEN MAY 2006 AND SPRING 2010

VINELAND PERIODIC SAMPLING - SPRING 2010

Sampling Event	Frequency of Arsenic Detection in Samples (%)	Samples Exceeding Applicable Criteria (%)
May 2006	90	35
November 2006	90	40
September 2007	85	40
May 2009	89	39
November 2009	81	31
April / May 2010	94	40

TABLE 4-5. FREQUENCY OF ARSENIC DETECTION AND EXCEEDENCES IN BEACH SOIL SAMPLES COLLECTED BETWEEN MAY 2006 AND SPRING 2010

VINELAND PERIODIC SAMPLING - SPRING 2010

Sampling Event	Frequency of Arsenic Detection in Samples (%)	Samples Exceeding Applicable Criteria (%)
May 2006	40	0
November 2006	20	0
September 2007	20	0
May 2009	20	0
November 2009	20	0
April / May 2010	40	0

TABLE 4-6. COMPARISON OF ARSENIC RESULTS FOR SAMPLES COLLECTED IN VICINITY OF VINELAND CHEMICAL SUPERFUND SITE BETWEEN MAY 2006 AND SPRING 2010

VINELAND PERIODIC SAMPLING - SPRING 2010

Sampling Station	Units	May 2006 Baseline Sampling	November 2006 Periodic Sampling	September 2007 Post Remedial Action Sampling	Periodic Sampling - Spring 2009 (May)	Periodic Sampling - Fall 2009 (November)	Periodic Sampling - Spring 2010 (April and May)
Water Sample Results							
1) MILL-WAT1	µg/L	**200**	U	U	-	-	-
1) MILL-WAT2	µg/L	U	**900**	**3,800**	-	-	-
2) R55-WAT1	µg/L	**14**	**8.8**	**14**	U	-	-
2) R55-WAT2	µg/L	**1,900**	**660**	**700**	**12,000**	-	-
3) BWB-WAT1	µg/L	U	U	U	U	U	U
3) BWB-WAT2	µg/L	U	U	U	U	U	**58**
4) ALLIANCE-WAT1	µg/L	U	U	U	U	U	U
4) ALLIANCE-WAT2	µg/L	U	U	U	**9.4**	U	U
5) ALMOND-WAT1	µg/L	U	U	U	U	U	U
5) ALMOND-WAT2	µg/L	U	U	**16**	U	U	U
6) BA-WAT1	µg/L	U	U	**13**	U	U	**8.9**
6) BA-WAT2	µg/L	U	U	U	**65**	U	**370**
7) SHERMAN-WAT1	µg/L	U	U	**12**	U	U	U
7) SHERMAN-WAT2	µg/L	**55**	**11**	**100**	U	**20**	U
8) NUL-WAT1	µg/L	U	U	U	U	U	U
8) NUL-WAT2	µg/L	U	U	**22**	U	**230**	**76**
9) ULB-WAT1	µg/L	U	U	U	U	**10**	**14**
9) ULB-WAT2	µg/L	U	U	**15**	U	**1100**	**120**
10) SUL-WAT1	µg/L	U	U	U	U	**9.2**	U
10) SUL-WAT2	µg/L	**10**	U	**28**	**550**	**19**	**14**
Sediment Results							
1) MILL-SED	mg/Kg	**14**	**160**	**8.2**	-	-	-
2) R55-SED	mg/Kg	**1,500**	**2,100**	**1,700**	**340**	-	-
3) BWB-SED	mg/Kg	**0.78**	**20**	**1.5**	**1.2**	**1.1**	**3.1**
4) ALLIANCE-SED	mg/Kg	**1.9**	**1.3**	U	U	**0.79**	**2**
5) ALMOND-SED	mg/Kg	**2.5**	**1.4**	**1.3**	**1.5**	**0.94**	**1.2**
6) BA-SED	mg/Kg	**1.2**	**2.6**	**2.3**	**2.3**	U	**120**
7) SHERMAN-SED	mg/Kg	**12**	**7.3**	**110**	**3.3**	**1.8**	**3.8**
8) NUL-SED	mg/Kg	**230**	**510**	**30**	**190**	**14**	**410**
9) ULB-SED	mg/Kg	**400**	**330**	**360**	**280**	**330**	**330**
10) SUL-SED	mg/Kg	**160**	**10**	**18**	**28**	**40**	**9.8**
Shore Results							
1) MILL-SHORE	mg/Kg	**270**	**140**	**130**	-	-	-
2) R55-SHORE	mg/Kg	**1,200**	**4,500**	**3,400**	**2,100**	-	-
3) BWB-SHORE	mg/Kg	U	**19**	**2**	**10**	**21**	**150**
4) ALLIANCE-SHORE	mg/Kg	U	**1.5**	U	**1.2**	U	**0.84**
5) ALMOND-SHORE	mg/Kg	**1**	U	U	U	U	U
6) BA-SHORE	mg/Kg	**1.3**	**4.5**	**290**	**21**	**280**	**160**
7) SHERMAN-SHORE	mg/Kg	**6.3**	U	**5.5**	**2.7**	**1.5**	**3.7**
8) NUL-SHORE	mg/Kg	**88**	**340**	**320**	**130**	**65**	**110**
9) ULB-SHORE	mg/Kg	**2.4**	**8.1**	**2.1**	**1.7**	**5.2**	2.3
10) SUL-SHORE	mg/Kg	**1.4**	**2.1**	**6.5**	**2.3**	**1**	**1.2**
Beach Results							
4) ALLIANCE-BEACH	mg/Kg	**1**	U	U	**1.2**	U	**0.67**
5) ALMOND-BEACH	mg/Kg	U	U	U	U	U	U
6) BA-BEACH	mg/Kg	U	U	U	U	U	U
9) ULB-BEACH	mg/Kg	**0.9**	**1.1**	**1**	U	**0.91**	**1.1**
10) SUL-BEACH	mg/Kg	U	U	U	U	U	0.53

NOTES:

U = undetected arsenic

Bold values represent detected arsenic concentrations; shaded and bolded values indicate arsenic exceedences as noted below:

Site Clean-up Level for Solids = 20 ppm (mg/Kg)

USEPA Drinking Water Criterion for Water = 10 ppb (µg/L)

"-" = no sample collected

TABLE 4-7. ARSENIC CONCENTRATIONS (µg/L) IN WATER SAMPLES COLLECTED IN VICINITY OF VINELAND CHEMICAL SUPERFUND SITE, 1992-2010

VINELAND PERIODIC SAMPLING - SPRING 2010

Non-agitated Water Samples

Sample Location	Sampling Year					
	May 2006+	Nov 2006+	Sept 2007+	May 2009+	Nov 2009+	April 2010+
4) Alliance Beach	ND	ND	ND	ND	ND	ND
5) Almond Beach	ND	ND	ND	ND	ND	ND
6) "Bare A" Beach	ND	ND	**13**	ND	ND	8.9
9) Union Lake Beach	ND	ND	ND	ND	**10**	**14**
10) South End Union Lake Beach	ND	ND	ND	ND	9.2	ND
USEPA Drinking Water Criterion (ppb)	10	10	10	10	10	10

+ Data from 2006 through 2010 are presented as WAT1

Agitated Water Samples

Sample Location	Sampling Year												
	1992**	1994**	1995**	1996**	1997**	1998**	1999**	May 2006•	Nov 2006•	Sept 2007•	May 2009•	Nov 2009•	April 2010•
4) Alliance Beach	**520**	**23**	**100**	**40**	**110**	**120**	**240**	ND	ND	ND	9.4	ND	ND
5) Almond Beach	**150**	**23**	**200**	**110**	**20**	**54**	**110**	ND	ND	**16**	ND	ND	ND
6) "Bare A" Beach	**36**	**39**	**77**	**85**	**21**	**99**	**10**	ND	ND	ND	**65**	ND	**370**
9) Union Lake Beach	NS	NS	NS	**16**	6.6	8.8	6	ND	ND	**15**	ND	**1100**	**120**
10) South End Union Lake Beach	NS	NS	NS	NS	NS	**26**	**20**	**10**	ND	**28**	**550**	**19**	14
USEPA Drinking Water Criterion (ppb)	10	10	10	10	10	10	10	10	10	10	10	10	10

• Data from 2006 through 2010 are presented as WAT2

NOTE: Shaded and bold values represent detected arsenic concentrations equivalent to or above the USEPA Drinking Water Criterion of 10 ug/L (ppb) for arsenic

NS = no sample collected; ND = not detected; below analytical limit

**Historical data from (USEPA/ERTC 1999) citation

NOTE: May 2006 data from (EA 2006a), November 2006 data from (EA 2007), September 2007 data from (EA 2008), May 2009 data from (EA 2009), and November 2009 data from (EA 2010)

TABLE 4-8. ARSENIC CONCENTRATIONS (mg/Kg) IN BEACH (SOIL) SAMPLES COLLECTED IN VICINITY OF VINELAND CHEMICAL SUPERFUND SITE, 1992-2010

VINELAND PERIODIC SAMPLING - SPRING 2010

Sample Location	Sampling Year												
	1992*	1994*	1995*	1996*	1997*	1998*	1999*	May 2006**	Nov 2006**	Sept 2007	May 2009	Nov 2009	April 2010
4) Alliance Beach	NS	*0.45 ND*	2.2	0.89	0.49	1.1	0.59	1	ND	ND	1.2	ND	0.67
5) Almond Beach	NS	0.92	0.86	0.76	0.46	1	0.43	ND	ND	ND	ND	ND	ND
6) "Bare A" Beach	NS	*0.44 ND*	4	0.67	0.81	*0.41 ND*	*0.47 ND*	ND	ND	ND	ND	ND	ND
9) Union Lake Beach	NS	NS	NS	1.3	3.1	1.2	2.6	0.9	1.1	1	ND	0.91	1.1
10) South End Union Lake Beach	NS	NS	NS	NS	NS	2.3	*0.48 ND*	ND	ND	ND	ND	ND	0.53
Site Clean-up Level (mg/Kg)	20	20	20	20	20	20	20	20	20	20	20	20	20

NOTE: Italics = arsenic undetected at indicated concentration (detection limit)

NS = No sample collected; ND = not detected; below analytical detection limit

No beach (soil) samples exceeded the Site Clean-up Level of 20 mg/Kg for solids

*Historical data from (USEPA/ERTC 1999) citation

**May 2006 data from (EA 2006a) citation

TABLE 4-9. ARSENIC CONENTRATIONS (mg/Kg) IN SURFICIAL SEDIMENT SAMPLES COLLECTED IN VICINITY OF VINELAND CHEMICAL SUPERFUND SITE, 1992-2010

VINELAND PERIODIC SAMPLING - SPRING 2010

Sample Location	Sampling Year						
	1992*	1994*	1995*	1996*	1997*	1998*	1999*
4) Alliance Beach	11.1	9.65	7.75	1.6	2.2	4.2	6.7
5) Almond Beach	7.9	2	3.85	5.3	4.35	17	2.7
6) "Bare A" Beach	11.8	19.3	5.95	10.5	3.25	**38**	4.2
9) Union Lake Beach	NS	NS	NS	5	2.65	2.5	4.4
10) South End Union Lake Beach	NS	NS	NS	NS	NS	17.5	8.1
Site Clean-up Level (mg/Kg)	20	20	20	20	20	20	20

Sample Location	Sampling Year											
	May 2006-sed	May 2006-shore	Nov 2006-sed	Nov 2006-shore	Sept 2007-sed	Sept 2007-shore	May 2009-sed	May 2009-shore	Nov 2009-sed	Nov 2009-shore	April 2010-sed	April 2010-shore
4) Alliance Beach	1.9	ND	1.3	1.5	ND	ND	ND	1.2	0.79	ND	2	0.84
5) Almond Beach	2.5	1	1.4	ND	1.3	ND	1.5	ND	0.94	ND	1.2	ND
6) "Bare A" Beach	1.2	1.3	2.6	4.5	2.3	**290**	2.3	**21**	ND	**280**	**120**	**160**
9) Union Lake Beach	**400**	2.4	**330**	8.1	**360**	2.1	**280**	1.7	**330**	5.2	**330**	2.3
10) South End Union Lake Beach	**160**	1.4	10	2.1	18	6.5	**28**	2.3	**40**	1	9.8	1.2
Site Clean-up Level (mg/Kg)	20	20	20	20	20	20	20	20	20	20	20	20

NOTE: Shaded and bold values represent detected arsenic concentrations equivalent to or above the Site Clean-up Level of 20 mg/Kg (ppm) of arsenic for solids
NS = No sample collected; ND = not detected; below analytical detection limit
*Historical data from (USEPA/ERTC 1999) citation

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APPENDIX A

ANALYTICAL RESULTS AND CHAIN-OF-CUSTODY (COC) FORMS FOR ARSENIC ANALYSES

Client: EA Engineering Science, and Technology, Inc. 15 Loveton Circle Sparks, MD 21152	Project Manager: Peggy Derrick Phone: 410-329-5126 Field Contact: Todd Ward Phone: 410-746-1250	Chain of Custody Record Laboratory: USEPA Region 2 Laboratory 2890 Woodbridge Ave. Edison, NJ 08837 Phone: 732-906-6886 ATTN: Mr. John Birri/John Bourbon
Project Name: 2010 Vineland Spring Monitoring Project#: 62305.01		
Page 1 of 3		

Date	Time	Water	Sediment	Sample Identification	No. of Containers	Arsenic EPA 200.7/6010B	Remarks
4/6/10	1350		X	ULB-SHORE-040610	1	X	
4/6/10	1355		X	ULB-BEACH-040610	1		Note: 28 day TAT required
4/6/10	1355		X	ULB-BEACH-MS-040610	1		
4/6/10	1355		X	ULB-BEACH-MSD-040610	1		JARS/BOTTLES with
4/6/10	1645		X	SUL-SHORE-040610	1		"M" on lid are
4/6/10	1650		X	SUL-BEACH-040610	1		28-day TAT
			X	DUP-3	1		
4/7/10	0920		X	BA-SHORE-040710	1		
	0928		X	BA-SED-040710	1		
	0930		X	BA-BEACH-040710	1		
	0930		X	BA-BEACH-MS-040710	1		
	0930		X	BA-BEACH-MSD-040710	1		
	0940	X		BA-WAT1-040710	1		
	0941	X		BA-WAT2-040710	1		
		X		DUP-4	1		
	1215	X		ALMOND-WAT1-040710	1		
	1215	X		ALMOND-WAT1-MS-040710	1		
	1215	X		ALMOND-WAT1-MSD-040710	1		

Sampled by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time
Todd Ward	4/8/10 0915	Todd Ward	4/8/10 1700
Relinquished by: (Signature)	Date/Time	Received by Laboratory: (Signature)	Date/Time

Client:	Project Manager:	Parameters/Method Numbers for Analysis	Chain of Custody Record
EA Engineering Science, and Technology, Inc.	**Peggy Derrick**		Laboratory: **USEPA**
	Phone: **410-329-5126**		**Region 2 Laboratory**
15 Loveton Circle	Field Contact:		**2890 Woodbridge Ave.**
Sparks, MD 21152	**Todd Ward**		**Edison, NJ 08837**
	Phone: **410-746-1250**		**Phone: 732-906-6886**
Project Name: **Vineland Fall Monitoring**			**ATTN: Mr. John Birri/John Bourbon**
Project#: 62305.01			
Page 2 of 3			

Date	Time	Water	Sediment	Sample Identification	No. of Containers	Arsenic EPA 200.7/6010B	Remarks
		X		DUP-5	1	X	
4/7/10	1220		X	ALMOND-SHORE-040710			Note: 28 day TAT required
4/7/10	1225		X	ALMOND-SED-040710			
			X	DUP-1			Jars/bottles with
			X	DUP-2			"M" on lid are
4/7/10	1520	X		ALLIANCE-WAT1-040710			28 day TAT
	1521	X		ALLIANCE-WAT2-040710			
	1525		X	ALLIANCE-SHORE-040710			
	1530		X	ALLIANCE-SED-040710			
	1535		X	ALLIANCE-BEACH-040710			
	1600	X		BWB-WAT1 (TW) -040710			
	1601	X		BWB-WAT2-040710			
	1620		X	BWB-SED-040710			
↓	1610		X	BWB-SHORE-040710			
4/6/10	1700	X		PBLANK-01-040610			
4/7/10	0700	X		PBLANK-02-040710			
4/7/10	0705	X		TTBLANK-040710			
4/7/10	1230		X	ALMOND-BEACH-040710			

Sampled by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time
Todd Ward	4/8/10 0915	Todd Ward	4/8/10 1700
Relinquished by: (Signature)	**Date/Time**	**Received by Laboratory: (Signature)**	**Date/Time**

Client:	Project Manager:	Parameters/Method Numbers for Analysis	Chain of Custody Record
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	Phone: **410-329-5126**		**Region 2 Laboratory**
15 Loveton Circle	Field Contact:		**2890 Woodbridge Ave.**
Sparks, MD 21152	**Todd Ward**		**Edison, NJ 08837**
	Phone: **410-746-1250**		**Phone: 732-906-6886**
Project Name: **Vineland Fall Monitoring**			**ATTN: Mr. John Birri/John Bourbon**
Project#: 62305.01			
Page 3 of 3			

Date	Time	Water	Sediment	Sample Identification	No. of Containers	Arsenic EPA 200.7/6010B	Remarks
4/7/10	1230		X	ALMOND-BEACH-MS-040710	1	X	
4/7/10	1230		X	ALMOND-BEACH-MSD-040710	1	X	Note: 28 day TAT required
4/8/10	0800	X		PBLANK-03-040810			
	0820	X		NUL-WAT1-040810			Jars/bottles with "M"
	0821	X		NUL-WAT2-040810			on lid are 28 day TAT
	0826	~~X~~	X	NUL-SED-040810			
	0830	~~X~~	X	NUL-SHORE-040810			
	0840	X		ULB-WAT1-040810			
	0842	X		ULB-WAT2-040810			
	0850		X	ULB-SED-040810			
	0905	X		SUL-WAT1-040810			
	0906	X		SUL-WAT2-040810			
	0910		X	SUL-SED-040810			
4/7/10	1216	X		ALMOND-WAT2-040710	1	X	

Sampled by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time
Todd Ward	4/8/10 0915	Todd Ward	4/8/10 1700
Relinquished by: (Signature)	**Date/Time**	**Received by Laboratory: (Signature)**	**Date/Time**

Client:	Project Manager:	Parameters/Method Numbers for Analysis	Chain of Custody Record
EA Engineering Science, and Technology, Inc.	**Peggy Derrick**		Laboratory: **USEPA**
	Phone: **410-329-5126**		**Region 2 Laboratory**
15 Loveton Circle	Field Contact:		**2890 Woodbridge Ave.**
Sparks, MD 21152	**Todd Ward**		**Edison, NJ 08837**
	Phone: **410-746-1250**		**Phone: 732-906-6886**
Project Name: 2010 **Vineland Spring Monitoring**			**ATTN: Mr. John Birri/John Bourbon**
Project#: 62305.01			
Page 1 of 7			

Date	Time	Water	Sediment	Sample Identification	No. of Containers	Arsenic EPA 200.7/6010B	Remarks
4/6/10	1215		X	ULBT1 - 1	1	X	
	1216		X	ULBT1 - 2	1		Note: 7 day TAT required
	1217		X	ULBT1 - 3	1		
	1218		X	ULBT1 - 4	1		
	1219		X	ULBT1 - 5	1		
	1225	X		ULBT1 - WAT1	1		
	1230	X		ULBT1 - WAT2	1		
	1257	X		ULBT1 - WAT3	1		
	1258	X		ULBT1 - WAT4	1		
	1235		X	ULBT2 - 1	1		
	1236		X	ULBT2 - 2	1		
	1237		X	ULBT2 - 3	1		
	1238		X	ULBT2 - 4	1		
	1239		X	ULBT2 - 5	1		
	1240	X		ULBT2 - WAT1	1		
	1245	X		ULBT2 - WAT2	1		
	1320	X		ULBT2 - WAT3	1		
↓	1321	X		ULBT2 - WAT4	1	↓	

Sampled by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time
Todd Ward	4/7/10 1515	Todd Ward	4/8/10 1700
Relinquished by: (Signature)	**Date/Time**	**Received by Laboratory: (Signature)**	**Date/Time**

Client:	Project Manager:
EA Engineering Science, and Technology, Inc.	**Peggy Derrick**
	Phone: **410-329-5126**
15 Loveton Circle	Field Contact:
Sparks, MD 21152	**Todd Ward**
	Phone: **410-746-1250**

Project Name: **Vineland Fall Monitoring**

Project#: 62305.01

Page 2 of 7

Date	Time	Water	Sediment	Sample Identification	No. of Containers	Arsenic EPA 200.7/6010B
4/6/10	1500		X	SULT1-1	1	X
	1505		X	SULT1-2		
	1510		X	SULT1-3		
	1515		X	SULT1-4		
	1520		X	SULT1-5		
	1525	X		SULT1-WAT1		
	1526	X		SULT1-WAT2		
	1530	X		SULT1-WAT3		
	1531	X		SULT1-WAT4		
	1550		X	SULT2-1		
	1555		X	SULT2-2		
	1600		X	SULT2-3		
	1605		X	SULT2-4		
	1610		X	SULT2-5		
	1615	X		SULT2-WAT1		
	1616	X		SULT2-WAT2		
	1620	X		SULT2-WAT3		
	1621	X		SULT2-WAT4		

Parameters/Method Numbers for Analysis

Chain of Custody Record

Laboratory:
USEPA
Region 2 Laboratory
2890 Woodbridge Ave.
Edison, NJ 08837

Phone: 732-906-6886

ATTN: Mr. John Birri/John Bourbon

Remarks

Note: 7 day TAT required

Sampled by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time
Todd Ward	4/7/10 1515	Todd Ward	4/8/10 1700
Relinquished by: (Signature)	Date/Time	Received by Laboratory: (Signature)	Date/Time

Client:	Project Manager:	Parameters/Method Numbers for Analysis	Chain of Custody Record
EA Engineering Science, and Technology, Inc. **15 Loveton Circle** **Sparks, MD 21152**	**Peggy Derrick** Phone: **410-329-5126** Field Contact: **Todd Ward** Phone: **410-746-1250**		Laboratory: **USEPA** **Region 2 Laboratory** **2890 Woodbridge Ave.** **Edison, NJ 08837** **Phone: 732-906-6886** **ATTN: Mr. John Birri/John Bourbon**
Project Name: **Vineland Fall Monitoring** Project#: 62305.01			
Page 3 of 7			

Date	Time	Water	Sediment	Sample Identification	No. of Containers	Arsenic EPA 200.7/6010B	Remarks
4/7/10	0745		X	BAT1-1	1	X	
	0745		X	BAT1-1-MS			Note: 7 day TAT required
	0745		X	BAT1-1-MSD			
	0750		X	BAT1-2			
	0755		X	BAT1-3			
	0800		X	BAT1-4			
↓	0805		X	BAT1-5			
			X	SED-DUP5			
4/7/10	0815	X		BAT1-WAT1			
	0816	X		BAT1-WAT2			
	0820	X		BAT1-WAT3			
	0821	X		BAT1-WAT4			
	0830		X	BAT2-1			
	0835		X	BAT2-2			
	0840		X	BAT2-3			
	0845		X	BAT2-4			
	0850		X	BAT2-5			
↓	0900	X		BAT2-WAT1	↓	↓	

Sampled by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time
Todd Ward	4/7/10 1515	Todd Ward	4/8/10 1700
Relinquished by: (Signature)	**Date/Time**	**Received by Laboratory: (Signature)**	**Date/Time**

Client:	Project Manager:	Parameters/Method Numbers for Analysis	Chain of Custody Record
EA Engineering Science, and Technology, Inc.	**Peggy Derrick**		Laboratory:
	Phone: **410-329-5126**		**USEPA**
15 Loveton Circle	Field Contact:		**Region 2 Laboratory**
Sparks, MD 21152	**Todd Ward**		**2890 Woodbridge Ave.**
	Phone: **410-746-1250**		**Edison, NJ 08837**
Project Name: **Vineland Fall Monitoring**			**Phone: 732-906-6886**
Project#: 62305.01			**ATTN: Mr. John Birri/John Bourbon**
Page 4 of 7			

Date	Time	Water	Sediment	Sample Identification	No. of Containers	Arsenic EPA 200.7/6010B	Remarks
4/7/10	0901	X		BAT2-WAT2	1	X	
	0907	X		BAT2-WAT3			Note: 7 day TAT required
	0908	X		BAT2-WAT4			
	1030		X	ALMONDTI-1			
	1030		X	ALMONDTI-1-MS			
	1030		X	ALMONDTI-1-MSD			
	1035		X	ALMONDTI-2			
	1040		X	ALMONDTI-3			
	1045		X	ALMONDTI-4			
	1050		X	ALMONDTI-5			
			X	SED-DUP3			
4/7/10	1100	X		ALMONDTI-WAT1			
	1100	X		ALMONDTI-WAT1-MS			
	1100	X		ALMONDTI-WAT1-MSD			
	1105	X		ALMONDTI-WAT2			
	1110	X		ALMONDTI-WAT3			
	1111	X		ALMONDTI-WAT4			
		X		WATER-DUP3			

Sampled by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time
Todd Ward	4/7/10 1515	Todd Ward	4/8/10 1700
Relinquished by: (Signature)	Date/Time	Received by Laboratory: (Signature)	Date/Time

Client:	Project Manager:	Parameters/Method Numbers for Analysis	Chain of Custody Record
EA Engineering Science, and Technology, Inc.	**Peggy Derrick**		Laboratory: **USEPA**
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Sparks, MD 21152	**Todd Ward**		**Edison, NJ 08837**
	Phone: **410-746-1250**		**Phone: 732-906-6886**
Project Name: 2010 **Vineland Spring Monitoring**			**ATTN: Mr. John Birri/John Bourbon**
Project#: 62305.01			
Page 5 of 7			

Date	Time	Water	Sediment	Sample Identification	No. of Containers	Arsenic EPA 200.7/6010B	Remarks
4/7/10	1120		X	ALMONDT2-1	1	X	
	1120		X	ALMONDT2-1-MS			Note: 7 day TAT required
	1120		X	ALMONDT2-1-MSD			
	1125		X	ALMONDT2-2			
	1130		X	ALMONDT2-3			
	1135		X	ALMONDT2-4			
↓	1140		X	ALMONDT2-5			
			X	SED-DUP4			
4/7/10	1150	X		ALMONDT2-WAT1			
	1150	X		ALMONDT2-WAT1-MS			
	1150	X		ALMONDT2-WAT1-MSD			
	1155	X		ALMONDT2-WAT2			
	1200	X		ALMONDT2-WAT3			
↓	1201	X		ALMONDT2-WAT4			
		X		WATER-DUP4			
4/7/10	1325		X	ALLIANCET1-1			
	1325		X	ALLIANCET1-1-MS			
↓	1325		X	ALLIANCE T1-1-MSD	↓	↓	

Sampled by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time
Todd Ward	4/7/10 1515	Todd Ward	4/8/10 1700
Relinquished by: (Signature)	**Date/Time**	**Received by Laboratory: (Signature)**	**Date/Time**

Client:	Project Manager:	Parameters/Method Numbers for Analysis	Chain of Custody Record
EA Engineering Science, and Technology, Inc.	**Peggy Derrick**		Laboratory: **USEPA**
	Phone: **410-329-5126**		**Region 2 Laboratory**
15 Loveton Circle	Field Contact:		**2890 Woodbridge Ave.**
Sparks, MD 21152	**Todd Ward**		**Edison, NJ 08837**
	Phone: **410-746-1250**		**Phone: 732-906-6886**
Project Name: **Vineland Fall Monitoring**			**ATTN: Mr. John Birri/John Bourbon**
Project#: 62305.01			
Page 6 of 7			

Date	Time	Water	Sediment	Sample Identification	No. of Containers	Arsenic EPA 200.7/6010B	Remarks
4/7/10	1330		X	ALLIANCE T1-2	1	X	
	1335		X	ALLIANCE T1-3			Note: 7 day TAT required
	1340		X	ALLIANCE T1-4			
	1345		X	ALLIANCE T1-5			
			X	SED-DUP1			
4/7/10	1400	X		ALLIANCE T1-WAT1			
	1400	X		ALLIANCE T1-WAT1-MS			
	1400	X		ALLIANCE T1-WAT1-MSD			
	1401	X		ALLIANCE T1-WAT2			
	1407	X		ALLIANCE T1-WAT3			
	1408	X		ALLIANCE T1-WAT4			
		X		WATER-DUP1			
4/7/10	1425		X	ALLIANCE T2-1			
	1425		X	ALLIANCE T2-1-MS			
	1425		X	ALLIANCE T2-1-MSD			
	1430		X	ALLIANCE T2-2			
	1435		X	ALLIANCE T2-3			
	1440		X	ALLIANCE T2-4			

Sampled by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time
Todd Ward	4/7/10 1515	Todd Ward	4/8/10 1700
Relinquished by: (Signature)	**Date/Time**	**Received by Laboratory: (Signature)**	**Date/Time**

Client:	Project Manager:	Parameters/Method Numbers for Analysis	Chain of Custody Record
EA Engineering Science, and Technology, Inc. **15 Loveton Circle** **Sparks, MD 21152**	**Peggy Derrick** Phone: **410-329-5126** Field Contact: **Todd Ward** Phone: **410-746-1250**		Laboratory: **USEPA** **Region 2 Laboratory** **2890 Woodbridge Ave.** **Edison, NJ 08837** **Phone: 732-906-6886** **ATTN: Mr. John Birri/John Bourbon**
Project Name: **Vineland Fall Monitoring** Project#: 62305.01			
Page 1 of 1			

Date	Time	Water	Sediment	Sample Identification	No. of Containers	Arsenic EPA 200.7/6010B	Remarks
5/19/10	0940		X	SHERMAN-SED-051910	1	X	
↓	0945		X	SHERMAN-SHORE-051910	1	X	NOTE: 7 DAY TAT
	0950	X		SHERMAN-WAT1-051910	1	X	REQUIRED
↓	0951	X		SHERMAN-WAT2-051910	1	X	

Sampled by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time
Todd Ward	5/19/10 0951	Todd Ward	5/19/10 1223
Relinquished by: (Signature)	**Date/Time**	**Received by Laboratory: (Signature)**	**Date/Time**
		Michelle L. Peña	5/19/10 12:24

APPENDIX B

FIELD DOCUMENTATION AND LOGBOOK

VINELAND

Spring Monitoring 2010

Additional Beach Transects

31 March 2010 - Mobile & Blue water anchored upcurrent from dump site.
Sampled at approx. 1 meter below surface of water.

YSI at MOOMDS

Temp	Cond	Sal	DO	pH	Turb
8.32	36.23	26.72	6.60	8.11	12.7
7.78	49.11	37.95	3.02	7.81	13.0
7.71	49.19	38.04	2.17	7.83	13.6

Leave MOOMDS and head to TOB

6 April 2010

VINELAND Spring 2010 Monitoring and ADDITIONAL BEACH TRANSECTS

1130 - arrive @ Union Lake Beach Tennis and Sailing Club

Coordinates NJ NAD83, feet

Additional Beach Transects

Sample ID	Depth (ft)	N	E	Time	Approx. Dist. from Shore
ULBTI-1	2.7	210370.1	335317.9	1215	66
-2	2.65	210358.9	335323.7	1216	53
-3	2.4	210351.6	335336.3	1217	40
-4	1.9	210342.9	335343.9	1218	27
-5	0	210314.3	335357.1	1219	0
ULBTI-WAT1	2.7	210370.1	335317.2	1225	66
-WAT2	~~2.7~~			1230	
-WAT3	0	210316.3	335357.1	1257	0
-WAT4	0			1255	
ULBT2-1	2.8	210436.6	335367.1	1235	51
-2	2.5	210427.5	335372.5	1236	38
-3	2.1	210415.9	335380.4	1237	25
-4	~~1.9~~ 2.1 ~~2.1~~	210403.1 ~~210403.1~~	335390.5	1238	12
-5	0.6	210383.4	335410.9	1239	0
ULBT2-WAT1	2.8ft	210436.6	335357.1	1240	66
-WAT2				1245	
-WAT3	0.6ft			1320	0
-WAT4		210383.4	335410.9	1321	

Note: WAT 1 and WAT3 - pre-agitated
WAT 2 and WAT4 - post-agitated

6 APRIL 2010

Union Lake Beach

Monitoring Samples

Sample ID	Time	N	E	Depth
ULB-Shore-040610	1350	210,332.5	335,336.4	1.8 ft
ULB-Beach-040610	1355	210341.6	335388.5	–
ULB-Beach-MS-040610	1355	↓	↓	–
ULB-Beach-MSD-040610	1355			–

1400 - wat. qual @ ULB

Temp = 19.62 °C pH = 6.6

Cond = 0.1 mS/cm Turb = 4.4 NTU

Sal = 0.05 ppt

D.O. = 9.74 mg/L

1430 - arrive @ South End Union Lake

Additional Beach Transects

Sample ID	Time	Depth (ft)	N	E	Approx. Distance (ft)
SULT1-1	1800	3.0	208,789.3	336,509.1	42
-2	1805	2.5	208,791.4	336,516.9	32
-3	1810	1.9	208,791.4	336,523.6	22
-4	1815	1.2	208,794.8	336,534.5	12
-5	1820	0	208,795.8	336,546.6	0
SULT1-WAT1	1825	3.0	208,789.3	336,509.1	42
-WAT2	1826				
-WAT3	1830	0	208,795.8	336,546.6	0
-WAT4	1831				

6 April 2010

Additional Beach Transects

Sample ID	Time	Depth (ft)	N	E	Approx. Distance (ft)
SULT2-1	1550	2.9	208,872.1	336,488.7	41
-2	1855	2.3	208,872.9	336,497.0	32
-3	1900	1.9	208,873.4	336,503.5	23
-4	1905	1.4	208,874.9	336,516.1	14
-5	1910	0.4	208,873.5	336,530.1	0
SULT2-WAT1	1915	2.9	208,872.1	336,488.9	41
-WAT2	1916				
-WAT3	1920	0.4	208,873.5	336,530.1	0
-WAT4	1921				

Monitoring Samples

Sample ID	Time	N	E	Depth
SUL-Shore-040610	1645	208,754.9	336,534.5	2.0
SUL-Beach-040610	1650	208,768.3	336,561.7	–
↳ DUP-3				–

1635 - wat. qual @ South Union Lake Beach

Temp = 19.76 pH = 6.41

Cond = 0.101 Turb. = 1.7

Sal = 0.05

DO = 9.62

1700 - PBLANK-01-040610 equip. blank

7 April 2010

0700 - PBLANK-02-040710

0705 - TTBLANK-040710

Additional Beach Transects

Sample ID	Time	Depth (ft)	N	E	Approx Dist. (ft)
BAT1-1	0745	3	237,978.5	330,371.4	19
-1-MS	0745	"	"	"	19
-1-MSD	0745	"	"	"	19
-2	0750	2.5	237,979.3	330,372.8	14.5
-3	0755	2.2	237,978.8	330,375.5	10
-4	0800	2.2	237,980.1	330,380.8	5.5
-5	0805	0.6	237,979.1	330,387.1	0
↳ SED-DUP5		0.6			
BAT1-WAT1	0815	3.0	237,978.5	330,371.4	19
-WAT2	0816				
-WAT3	0820	0	237,979.1	330,387.1	0
-WAT4	0821				

0917 - wind gust @ BA Beach

Temp = 18.77 DO = 6.19

Cond = 0.110 pH = 6.17

Sal. = 0.05 Turb. = 0.2

7 April 2010

Additional Beach Transects

Sample ID	Time	Depth	N	E	Approx Dist. (ft)
BAT2-1	0830	3.6	238,001.7	330,370.2	20
-2	0835	2.6	238,007.2	330,372.3	15
-3	0840	2.5	238,007.5	330,376.3	10
-4	0845	1.7	238,007.2	330,381.1	5
-5	0850	0.7	238,011.1	330,382.7	0
BAT2-WAT1	0900	3.6	238,001.7	330,370.2	20
-WAT2	0901				
-WAT3	0907	0.7	238,011.1	330,382.7	0
-WAT4	0908				

MONITORING

BA-SMORE-040710	0920	N 238004.7 E 330376.0 Depth = 2.1
BA-SED-040710	0928	N 238008.1 E 330366.5 Depth = 3.7 ft
BA-BEACH-040710	0930	N 238012.4 E 330401.9
-MS-040710	0930	
-MSD-040710	0930	
BA-WAT1-040710	0940	~~N 238004.7~~ E 330376.0
BA-WAT2-040710	0941	N 238008.1 E 330366.5 D = 3.7 ft
↳ DUP-4		

7 April 2010

0958 - arrive @ Almond Beach

Additional Beach Transects

Sample ID	Time	Depth (ft)	N	E	Approx. Dist. (ft)
ALMOND T1-1	1030	2.7	241, 832.4	329, 508.3	50
-1-MS	1030	2.7	"	"	"
-1-MSD	1030	2.7	"	"	"
-2	1035	2.4	241, 833.1	329, 518.2	38
-3	1040	2.4	241, 834.0	329, 525.1	26
-4	1045	2.3	241, 838.7	329, 534.8	14
-5	1050	0	241, 837.3	329, 552.5	0
↳ SED-DUP3					
ALMOND T1-WAT1	1100	2.7	241, 832.4	329, 508.3	50
-WAT1-MS	1100				
-WAT1-MSD	1100				
-WAT2	1105				
-WAT3	1110	0	241, 837.3	329, 552.5	0
-WAT4	1111				
↳ WATER-DUP3					

1206 - wat. qual @ Almond Beach

Temp = 19.65 DO = 8.35

Cond. = 0.110 pH = 6.16

Sal = 0.05 Turb. = 0.7

7 April 2010

Additional Beach Transects

Sample ID	Time	Depth (ft)	N	E	Approx. Dist. (ft)
Almond T2-1	1120	3.3	241, 884.6	329, 524.8	26
-1-MS	1120	"	"	"	"
-1-MSD	1120	"	"	"	"
-2	1125	2.65	241, 884.1	329, 531.4	19.5
-3	1130	2.2	241, 885.8	329, 537.0	13.0
-4	1135	1.5	241, 884.0	329, 544.5	6.5
-5	1140	0	241, 889.4	329, 550.5	0
↳ SED-DUP4					
Almond T2-WAT1	1150	3.3	241, 884.6	329, 524.8	26
-WAT1-MS	1150				
-WAT1-MSD	1150				
-WAT2	1155				
-WAT3	1200	0	241, 889.4	329, 550.5	0
-WAT4	1201				
↳ WATER-DUP4					

MONITORING

ALMOND-WAT1-040710	1215	2.4 ft depth		
-MS-040710	1215	241, 838.0	329, 542.0	
-MSD-040710	1215			
-WAT2-040710	1216			
↳ DUP-5				
ALMOND-SHORE-040710	1220	241, 835.6 D = 2.0	329, 541.4	
↳ DUP-1				
ALMOND-SED-040710	1225	241, 838.0 D = 2.4 ft	329, 542.0	
↳ DUP-2				

7 April 2010

MONITOR

ALMOND - BEACH - 040710 1230 N 241,844.9

- MS - 040710 1230 E 329,555.8

- MSD - 040710 1230

1300 - Arrive @ Alliance Beach

Sample ID	Time	Depth (ft)	N	E	Additional Beach Transect Approx. Dist.
Alliance T1 - 1	1325	3.0	243,960.7	328,590.1	38
- 1 - MS	1325	"			"
- 1 - MSD	1325	"			"
- 2	1330	2.5	243,962.9	328,581.5	28.5
- 3	1335	1.9	243,966.4	328,574.0	19.0 ~~20.5~~ TW
- 4	1340	2.3	243,970.7	328,568.0	9.5 ~~10.5~~ TW
- 5	1345	0	243,976.4	328,557.6	0
↳ SED - DUP1		0	"	"	0
Alliance T1 - WAT1	1400	3.0	243,960.7	328,590.1	38
- WAT1 - MS	1400				
- WAT1 - MSD	1400				
T1 - WAT2	1401				
T1 - WAT3	1407	0	243,976.4	328,557.6	0
T1 - WAT4	1408				
↳ WATER - DUP1					

~~1632 - wat. qual. @ Alliance Beach~~

Temp = 21.10 DO = 10.26

Cond. = 0.111 pH = 6.18

Sal. = 0.05 Turb. = ~~0.~~ 1.2 TW

7 April 2010

Sample ID	Time	Depth	N	E	Approx. Dist.
Alliance T2 - 1	1425	3.0	243,915.0	328,574.8	35
- 1 - MS	1425	"	"	"	"
- 1 - MSD	1425	"	"	"	"
- 2	1430	2.75	243,917.5	328,568.5	26
- 3	1435	2.4	243,919.6	328,560.3	17
- 4	1440	1.6	243,922.4	328,553.2	8
- 5	1445	0	243,925.9	328,544.3	0
↳ SED - DUP2					
Alliance T2 - WAT1	1455	3.0	243,915.0	328,574.8	35
- WAT1 - MS	1455				
- WAT1 - MSD	1455				
- WAT2	1456				
- WAT3	1500	0	243,925.9	328,544.3	0
- WAT4	1501				
↳ WATER - DUP2					

MONITOR

ALLIANCE - WAT1 - 040710 1520 N 243~~746~~,933.9 E 328587.8 D = ~~3.25~~

ALLIANCE - WAT2 - 040710 1521

ALLIANCE - SHORE - 040710 1525 N 243945.0 E 328576.0 D = 2.7 ft

ALLIANCE - SED - 040710 1530 N 243933.9 E 328587.8 D = 3.25 ft

ALLIANCE - BEACH - 040710 1535 N 243966.0 E 328540.6

7 April 2010

MONITOR

BWB Confluence

1600 040710
BWB-WAT1 N 244849.1 E 329104.7 D = 2.3
1601 -WAT2-040710 " "
1620 - BWB-SED-040710 N 244849.1 D = 2.3
E 329104.7
1610 - BWB-SHORE-040710 N 244878.9
E 329129.9

1600 - wat. qual. @ BWB
Temp. = 21.18 DO = 9.91
Cond = 0.111 pH = 6.34
Sal = 0.05 Turb. = 4.8

8 April 2010

0800 - PBlank-03-040810

NUL-WAT1-040810 0820 ~~1020~~ N 219637.5 D = 5.5 M
-WAT2-040810 0821 ~~1021~~ E 331304.8
NUL-SED-040810 0826
-SHORE-040810 0830 N 219449.1 D = 2.0 M
E 331334.7

8 April 2010

ULB-WAT1-040810 0840 N 210487.8
-WAT2- 0842 E 335160.0
-SED- 0850 Depth = 12.7 M

SUL-WAT1-040810 0905 N 208729.7
-WAT2- 0906 E 336396.6
-SED- 0910 Depth = 8.5

0941 - wat. qual @ North Union Lake
Temp = 19.36 DO = 6.32
Cond = 0.133 pH = 6.5
Sal. = 0.06 ~~Turb~~ Turb. = 0.5

19 MAY 2010

Vineland Spring Monitoring 2010

Sherman Ave. location

Sherman-Sed-051910	0940
Sherman-Shore-051910	0945
Sherman-Wat1-051910	0950
Sherman-Wat2-051910	0951

Coordinates	N	E
Sherman-Sed-051910	224398.4	330555.7
-Shore-051910	224387.0	330561.7
-WAT1-051910	224398.4	~~330555.7~~ 330555.7
-WAT2-051910	224398.4	330555.7

1008 - wat. qual. @ Sherman Ave.

Temp. = 13.8 °C

Cond. = 0.099 mS/cm

Sal. = 0.06 ppt

DO = 7.47 mg/L

pH = 6.20

Turb = 10.6 NTU

APPENDIX C

HISTORICAL ARSENIC DATA RESULTS (YEAR 1992 AND YEARS 1994 THROUGH 1999)

(USEPA/ERTC 1999)

FINAL REPORT
Vineland Chemical Site
Field Investigation
Vineland, Cumberland County, NJ
May 1999

U.S. EPA Work Assignment No.: 3-195
WESTON Work Order No.: 03347-143-001-3195-01
U.S. EPA Contract No.: 68-C4-0022

Prepared by:

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1.0 INTRODUCTION

1.1 Objective

The objective of this study was to collect sediment, soil and water data to assess the public health hazard for arsenic contamination at three beaches along the Maurice River, two beaches along Union Lake, a potable water well at the Union Lake Sailing and Tennis Club, and potable water wells at two houses adjacent to the Vineland Chemical site. The data was evaluated against human health risk based action levels. This study was part of an annual monitoring program performed at beaches along the Maurice River and Union Lake.

1.2 Site Background

The Vineland Chemical site is a 54-acre manufacturing facility located in Vineland, Cumberland County, NJ. The facility was involved in the production of arsenical herbicides, fungicides, and biocides since 1949. Arsenical feedstock compounds were historically stored in unprotected piles, a practice that has since been discontinued. This resulted in soil and groundwater contamination in the vicinity of the site. In addition, runoff during storm events and recharge of arsenic-bearing groundwater has contaminated the adjacent watershed, including the Blackwater Branch, Maurice River, and Union Lake. Arsenic-contaminated groundwater, process water, non-contact cooling water, and storm water runoff are currently treated on site. Effluent containing approximately 0.7 milligrams per liter (mg/L) arsenic is discharged from the wastewater treatment facility to an unlined lagoon where it percolates into the ground.

Previous studies have investigated the extent and magnitude of arsenic contamination in the Maurice River watershed (Faust et al. 1983, Weston 1988). Data available concerning arsenic contamination indicates that both the water and sediment are contaminated downstream of the site. The maximum arsenic concentrations detected in surface water, sediment and interstitial water were 2,780 micrograms per Liter (μg/L), 14,000 milligrams per kilogram (mg/kg) and 12.5 mg/L, respectively. The New Jersey Department of Environmental Protection (NJ DEP) and the United States Environmental Protection Agency (U.S. EPA) standards for arsenic in drinking water are 0.05 mg arsenic/L (U.S. EPA 1993). The extent of arsenic contamination ranges from the Blackwater Branch in the vicinity of the Vineland Chemical facility to a point approximately 26.5 miles downstream from the site.

Sediment, soil and surface water samples were collected at four beaches downstream of the site as part of an annual monitoring program (Weston 1992, 1995a, 1995b, 1996, 1997, 1998). In addition, potable water samples were collected from a well downstream of the site in 1996 and 1997. In 1998, additional potable water samples were collected at two houses adjacent to the Vineland Chemical property. Arsenic was not detected in any of the well samples.

In May 1999, the U.S. EPA Region II requested that the U.S. EPA/Environmental Response Team Center (ERTC) collect sediment, soil and water samples from three beaches along the Maurice River, two beaches at Union Lake, and potable water samples from the Union Lake Sailing and Tennis Club and from two houses adjacent to the site.

2.0 METHODOLOGY

2.1 Field Sampling Design

The sampling was conducted to assess the potential human exposure to arsenic and should not be interpreted as a comprehensive extent of contamination. The specific sampling locations were

determined by the U.S. EPA Region II Remedial Project Manager (RPM), Matthew Westgate (Figure 1). On 29 April 1999, two sediment, one soil and one disturbed water sample were collected at each of the five previously sampled beaches. The disturbed water sample was used to simulate potential human exposure to arsenic contaminated surface water and sediment during beach use. Potable water samples were collected from Union Lake Sailing and Tennis Club and from two houses adjacent to the site. The eight locations sampled were as follows:

Sampling Location	Description of Sampling Location
Alliance Beach	Upstream of Almond Beach, unmaintained public day-use area.
Almond Beach	Publicly maintained beach area approximately 100-150 feet long.
BA Beach	Downstream of Almond Beach, consisting of an unmaintained public day-use area.
Union Lake Beach	Privately maintained beach, downstream of the site.
Union Lakes Sailing and Tennis Club	Privately maintained club, downstream of the site, potable water well.
South End of Union Lake Beach	Publicly maintained beach at the southern end of Union Lake.
House #1	1618 Wheat Rd., across from the site.
House #2	1509 Wheat Rd., adjacent to the site.

All beach sampling areas were characterized by shallow depth (less than three feet), gradual slope and sluggish flow. The sediment was sandy near the shore with coarser sand and small to medium gravel in deeper areas. Thin deposits of black silt were evident at depositional areas along the bottom.

A Horiba U-10® Water Quality Monitoring Instrument was used at each sample location to measure temperature, pH, dissolved oxygen, conductivity, and salinity. The Horiba U-10® was operated according to the manufacturer's operating manual.

2.2 Sediment, Soil and Water Sampling

Two sediment samples were collected from each of the five beaches sampled using a decontaminated Ponar dredge according to ERTC/REAC SOP #2016, *Sediment Sampling*. One sediment sample was collected upstream of the beach and one downstream of the beach. Sediment was collected from depositional areas where there was evidence of black silt. The dredge contents were composited into an aluminum tray, homogenized and transferred to a labeled 8-ounce glass jar.

Surface soil samples (0-4 inches below ground surface) were collected from each beach area using plastic trowels according to ERTC/REAC SOP #2012, *Soil Sampling*. The soil sample was composited into an aluminum tray, homogenized and transferred to a labeled 8-ounce glass jar.

Surface water samples were collected as per modification of ERTC/REAC SOP #2013, *Water Sampling*. The modification included collecting samples directly into a 1-L polyethylene bottle while

Submerged bottle

disturbing the adjacent sediments. The samples were collected at a depth of 6 to 12 inches below the surface and approximately 6 inches above the bottom. The disturbed water sample was used to simulate potential human exposure to arsenic contaminated surface water and sediment during beach use.

The potable water samples were collected according to ERTC/REAC SOP #2051, *Potable Water Sampling*. All water samples were preserved after collection using 40 percent nitric acid to a pH of less than 2.

After each sample was collected, the labeled sample jars were placed in a resealable plastic bag and stored in a sample cooler on wet ice [4 degrees Celsius (°C)]. Field documentation (field logbook notes, and chain of custody forms) are located in Appendix A. The samples were delivered to the REAC Inorganic Laboratory in Edison, New Jersey, on 29 April 1999. The final analytical results are located in Appendix B.

3.0 RESULTS

3.1 Sediment Samples

Arsenic was detected in all sediment samples at concentrations ranging from 1.7 to 11 mg/kg (Table 1). The maximum concentration of arsenic (11 mg/kg) was detected in the upstream sample from the South end of Union Lake and the minimum concentration of arsenic (1.7 mg/kg) was detected in the downstream sample from BA Beach. Sediment grain size was qualitatively characterized as containing predominantly large grain sizes such as sand and small to medium gravel. Sediment collected from all five beaches contained a fine layer of highly suspendible silt.

3.2 Soil Samples

Arsenic was detected in three of the five beach soil samples at concentrations ranging from 0.43 to 2.6 mg/kg (Table 1). The maximum concentration of arsenic (2.6 mg/kg) was detected at Union Lake and the minimum concentration of arsenic (0.43 mg/kg) was detected at Almond Beach. Arsenic was not detected at BA Beach and at South End of Union Lake Beach above the method detection limit (MDL) of 0.41 mg/kg. The soil at all five locations consisted primarily of sand and some small gravel.

3.3 Water Samples

Arsenic was detected in all five surface water samples at concentrations ranging from 0.006 to 0.24 mg/L (Table 2). The maximum concentration of arsenic (0.24 mg/L) was detected at Alliance Beach and the minimum concentration of arsenic (0.006 mg/L) was detected at Union Lake. Arsenic was not detected (MDL = 0.002 mg/L) in Union Lake Sailing and Tennis Club, House #1 and House #2 potable water samples.

3.4 In-Situ Water Quality

In-situ water quality parameters were consistent at all locations (Table 3). Temperature ranged from 13.2 to 16.9 °C and dissolved oxygen ranged from 8.66 to 11.5 mg/L. The pH ranged from 5.7 to 8.69 standard units. Conductivity ranged from 0.061 to 0.095 millimhos per centimeter (mmhos/cm). Salinity was measured at zero parts per thousand (ppt) at all locations.

3.5 Field Blanks

Arsenic was not detected at concentrations above the MDL (0.002 mg/L for water and 0.48 mg/kg for soil and sediment) in any field blanks. As such, it is unlikely that any contamination can be attributed to improper sample collection and handling.

4.0 DISCUSSION AND SUMMARY

Arsenic was detected in sediment samples collected at all locations at concentrations ranging from 1.7 to 11 mg/kg. The sediment in the Maurice River and Union Lake contains a high content of organic matter. Arsenic is typically adsorbed to the organic portion of sediment (Eisler 1988). Therefore, the arsenic may have been bound to the fine organic matter that was observed in the sediment.

Arsenic was detected in three of the five soil samples collected at concentrations ranging from 0.43 to 2.6 mg/kg. The soil samples were composed of coarse sand and some small gravel with very little organic matter. Arsenic typically binds to the organic matter in soil (Eisler 1988). The lack of organic matter in these samples implies a lack of adequate binding sites for arsenic. Therefore, rain or other inputs may cause the leaching of arsenic out of the soil and may account for the low concentrations of arsenic in these soil samples.

Arsenic was detected in all five surface water samples at concentrations ranging from 0.006 mg/L to 0.24 mg/L. Arsenic concentrations were above the U.S. EPA drinking water standard of 0.05 mg/L (U.S. EPA 1993) at two of the five beaches sampled (Alliance Beach and Almond Beach). Water samples were collected while disturbing the sediments so that particles of the highly suspendible fine silt layer were incorporated in the sample. Arsenic detection may be attributed to the organic fraction of the disturbed sediments present in the water samples. Riedel *et al.* (1988) found that the predominate component of detectable arsenic in water is associated with the sediment solids. Arsenic was not detected (MDL = 0.002 mg/L) in the potable well water samples taken at the Union Lake Sailing and Tennis Club, House #1 or House #2.

Concentrations of arsenic in the surface water collected from the Maurice River tended to be higher than the concentrations in surface water collected from Union Lake, with the exception of the BA Beach sample. Several reasons for this appear to exist. First, the Maurice River is directly downstream of the point-source of contamination and flows into Union Lake. Second, other tributaries flowing into Union Lake may cause the dilution of arsenic concentrations detected at these locations.

There are a number of factors that affect arsenic concentrations, including storm events, groundwater flow, flooding, grain size and sampling technique. Historic data for sediment, soil and water were compiled in Table 4 and Figures 2-4. No trends are discernable in the data as the concentration of arsenic in all matrices have remained relatively constant over time.

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Table 1. Results of the Arsenic Analysis in Soil/Sediment
Vineland Chemical Site
Vineland, Cumberland County, New Jersey
May 1999

(Results reported in mg/kg)

Sample ID	Matrix	Location	Conc	MDL
A19255	Soil	Alliance Beach	0.59	0.41
A19256	Sediment upstream	Alliance-U	10	0.42
A19257	Sediment downstream	Alliance-D	3.4	0.41
A19251	Soil	Almond Beach	0.43	0.39
A19252	Sediment upstream	Almond-U	3.4	0.44
A19253	Sediment downstream	Almond-D	1.9	0.41
A19259	Soil	BA Beach	U	0.47
A19260	Sediment upstream	BA-U	6.6	0.41
A19261	Sediment downstream	BA-D	1.7	0.44
A19267	Soil	Union Lake	2.6	0.41
A19268	Sediment upstream	Union Lake-U	6.0	0.47
A19269	Sediment downstream	Union Lake-D	2.8	0.42
A19263	Soil	So. End Union Lake	U	0.48
A19264	Sediment upstream	So. End Union Lake-U	11	0.38
A19265	Sediment downstream	So. End Union Lake-D	5.1	0.42

MDL - method detection limit
U - not detected
mg/kg - milligram per kilogram

Table 2. Results of the Arsenic Analysis in Water
Vineland Chemical Site
Vineland, Cumberland County,New Jersey
May 1999

(Results reported in mg/L)

Sample ID	Location	Conc.	MDL
A19258	Alliance Beach	0.24	0.002
A19254	Almond Beach	0.11	0.002
A19262	BA Beach	0.01	0.002
A19270	Union Lake	0.006	0.002
A19271	Union Lake Yact Club House	U	0.002
A19266	South End Beach, Union Lake	0.02	0.002
A19272	House #1	U	0.002
A19273	House #2	U	0.002

MDL - method detection limit
U - not detected
mg/L - milligrams per Liter

Table 3. In-Situ Water Quality Parameters
Vineland Chemical Site
Vineland, New Jersey
May 1999

Location	Temperature (C)	Dissolved Oxygen (mg/L)	pH	Conductivity (mmhos/cm)	Salinity (ppt)
Alliance Beach	15.1	8.91	6.30	0.079	0.00
Almond Beach	13.5	8.66	6.40	0.077	0.00
B-A Beach	14.6	9.65	5.83	0.079	0.00
Union Lake	16.9	9.65	5.70	0.091	0.00
Union Lake Yact Club	14.8	11.50	7.00	0.061	0.00
So. End Union Lake	15.3	9.40	5.90	0.093	0.00
House #1	14.0	11.30	6.10	0.095	0.00
House #2	13.2	11.24	8.69	0.085	0.00

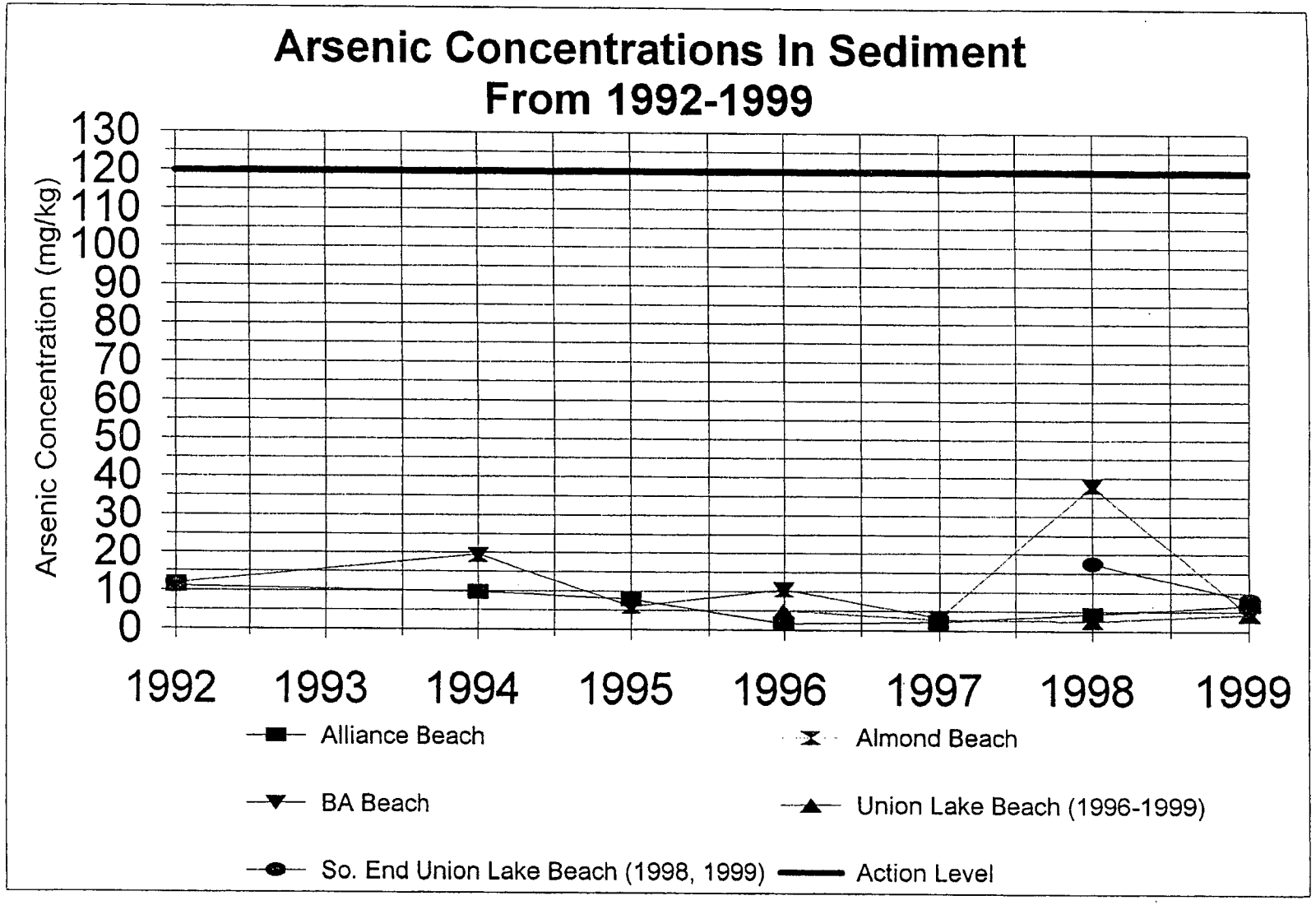
C - degrees Celsius
mg/L - milligrams of dissolved oxygen per liter of water
mmhos/cm - micromhos per centimeter
NTU - nephelometric turbidity units
ppt - parts per thousand

Table 4. Concentrations of Arsenic in Sediment, Soil and Water from 1992-1999
Vineland Chemical Site
Vineland, New Jersey
May 1999

Year Sampled	Matrix	Units	Alliance Beach	Almond Beach	BA Beach	Union Lake Beach	South End Union Lake Beach
1992	Water	(mg/L)	0.52	0.15	0.036	NS	NS
	Soil	(mg/kg)	NS	NS	NS	NS	NS
	Sediment	(mg/kg)	11.1	7.9	11.8	NS	NS
1994	Water	(mg/L)	0.023	0.023	0.039	NS	NS
	Soil	(mg/kg)	U (0.45)	0.92	U (0.44)	NS	NS
	Sediment	(mg/kg)	9.65	2	19.3	NS	NS
1995	Water	(mg/L)	0.1	0.2	0.077	NS	NS
	Soil	(mg/kg)	2.2	0.86	4	NS	NS
	Sediment	(mg/kg)	7.75	3.85	5.95	NS	NS
1996	Water	(mg/L)	0.04	0.11	0.085	0.016	NS
	Soil	(mg/kg)	0.89	0.76	0.67	1.3	NS
	Sediment	(mg/kg)	1.6	5.3	10.5	5	NS
1997	Water	(mg/L)	0.11	0.02	0.021	0.0066	NS
	Soil	(mg/kg)	0.49	0.46	8.1	3.1	NS
	Sediment	(mg/kg)	2.2	4.35	3.25	2.65	NS
1998	Water	(mg/L)	0.12	0.054	0.099	0.0088	0.026
	Soil	(mg/kg)	1.1	1	U (0.41)	1.2	2.3
	Sediment	(mg/kg)	4.2	17	38	2.5	17.5
1999	Water	(mg/L)	0.24	0.11	0.01	0.006	0.02
	Soil	(mg/kg)	0.59	0.43	U (0.47)	2.6	U (0.48)
	Sediment	(mg/kg)	6.7	2.7	4.2	4.4	8.1

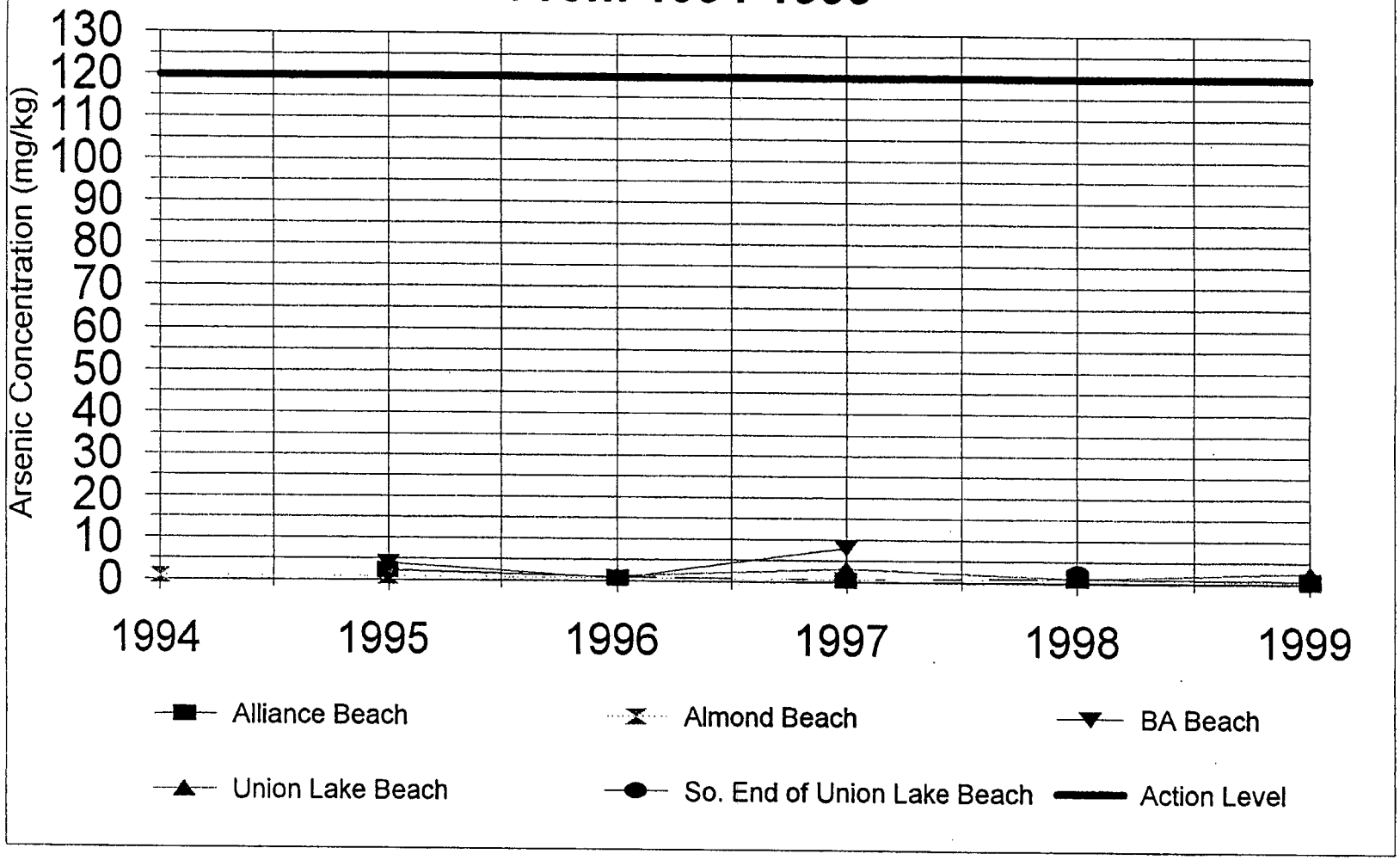
Note: Sediment concentrations reflect a mean of the upstream sample and the downstream sample
NS - Not Sampled
U - not detected at indicated concentration
Action Limit: Soil/Sediment - 120 mg/kg, Water - .05 mg/L
mg/L - milligrams per Liter
mg/kg - milligram per kilogram

\195\del\fr\9905\table99.wb2



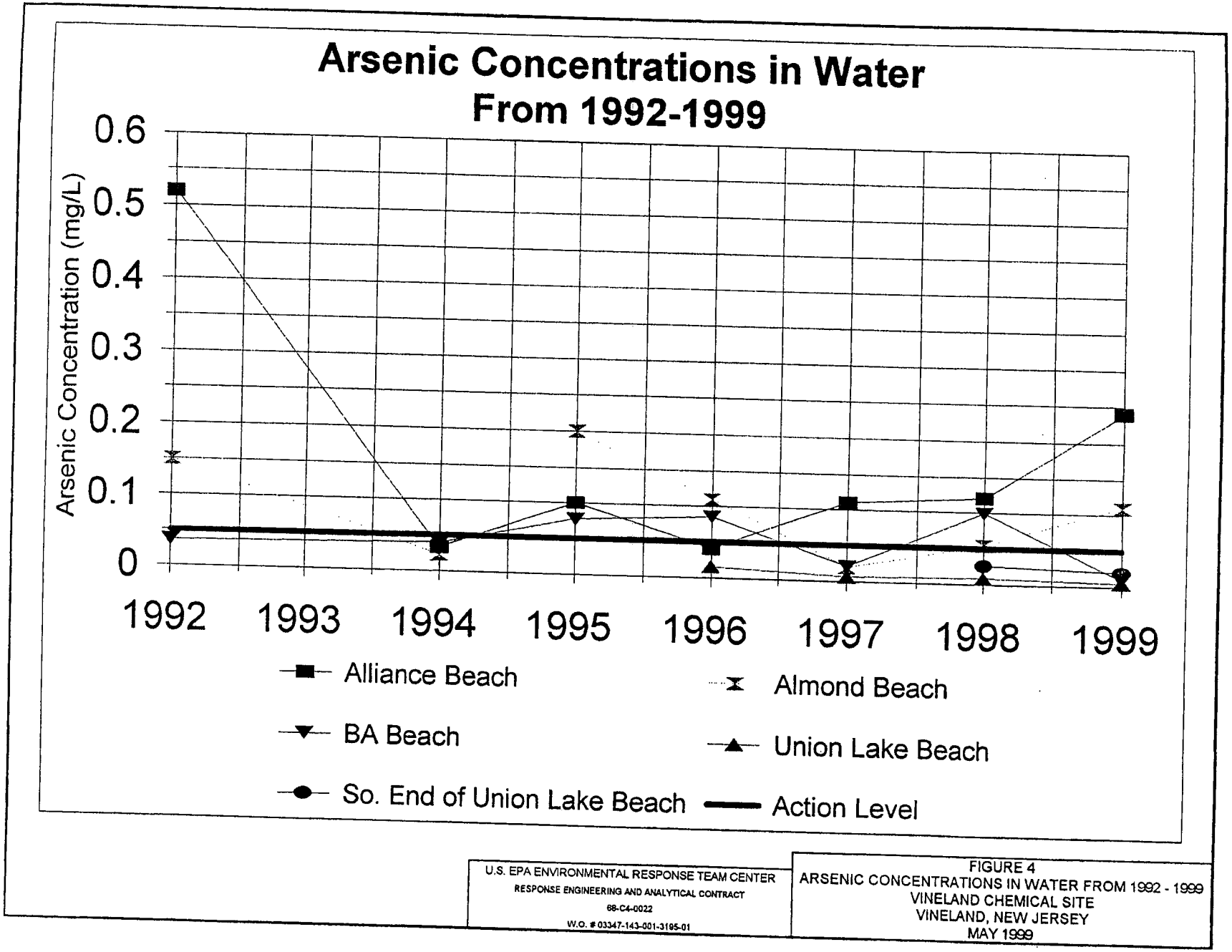
U.S. EPA ENVIRONMENTAL RESPONSE TEAM CENTER
RESPONSE ENGINEERING AND ANALYTICAL CONTRACT
68-C4-0022
W.O. # 03347-143-001-3196-01

FIGURE 2
ARSENIC CONCENTRATIONS IN SEDIMENT FROM 1992 - 1999
VINELAND CHEMICAL SITE
VINELAND, NEW JERSEY
MAY 1999



U.S. EPA ENVIRONMENTAL RESPONSE TEAM CENTER
RESPONSE ENGINEERING AND ANALYTICAL CONTRACT
68-C4-0022
W.O. # 03347-143-001-3195-01

FIGURE 3
ARSENIC CONCENTRATIONS IN SOIL FROM 1994 - 1999
VINELAND CHEMICAL SITE
VINELAND, NEW JERSEY
MAY 1999



U.S. EPA ENVIRONMENTAL RESPONSE TEAM CENTER
RESPONSE ENGINEERING AND ANALYTICAL CONTRACT
68-C4-0022
W.O. # 03347-143-001-3195-01

FIGURE 4
ARSENIC CONCENTRATIONS IN WATER FROM 1992 - 1999
VINELAND CHEMICAL SITE
VINELAND, NEW JERSEY
MAY 1999

APPENDIX A
Field Documentation
Vineland Chemical Site
Final Report
May 1999

4/29/99

Vineland

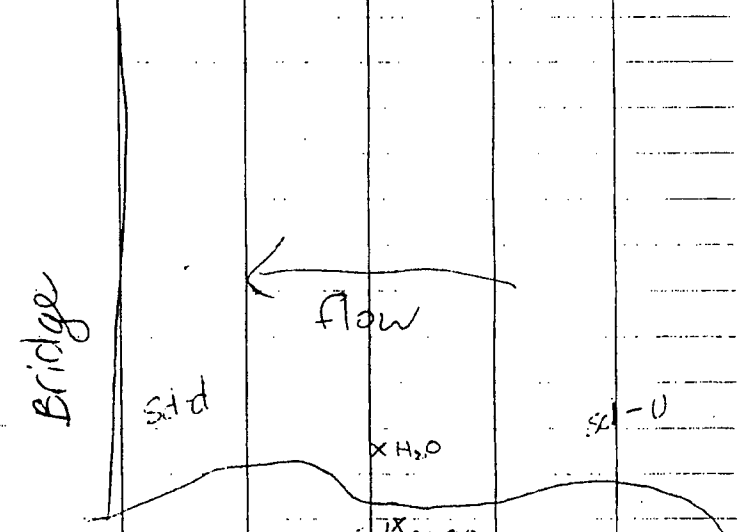
House #1 Across from site

pH - 6.1 note: started at 6 + decreased continuously
cond - .095
turb - 0
DO - 11.32
Temp - 14°C
Sal - 0

House #2 Adjacent to site
1509 Delsea Rd
Mrs Brown

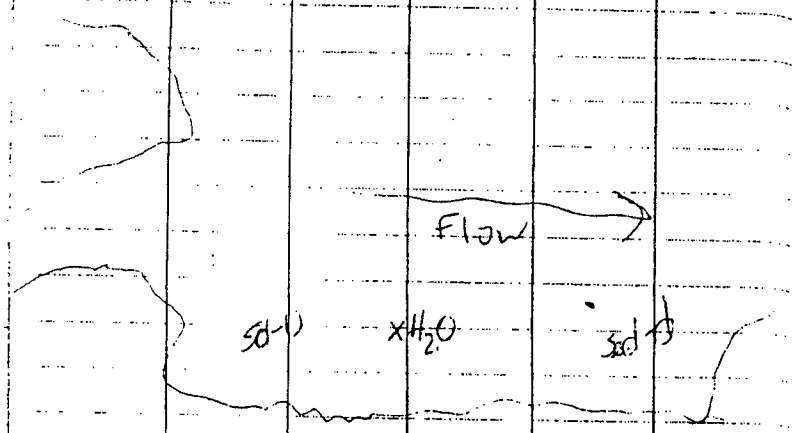
pH - 8.69
cond. - .085
turb. - 0
DO - 11.24
Temp - 13.2
sal - 0

Almond Beach



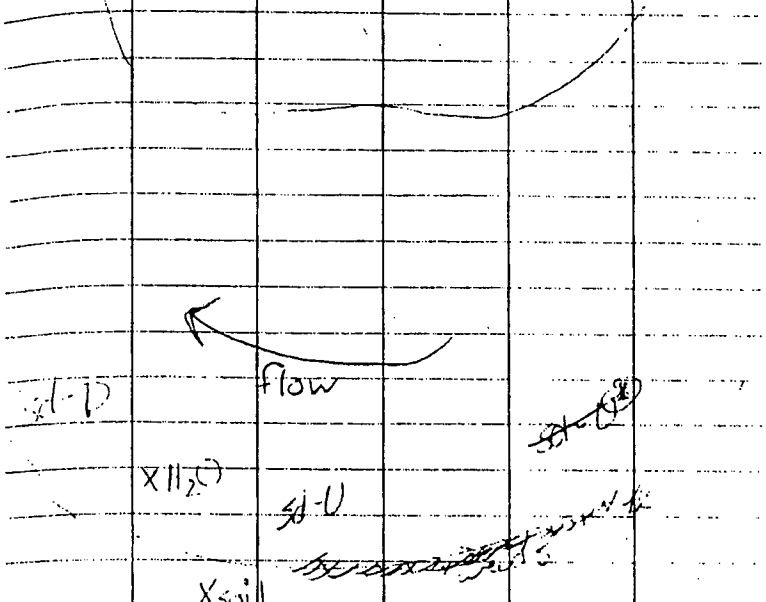
pH - 6.4
cond - .077
turb - 0
DO - 8.66
Temp - 13.5
sal - 0

Alliance Beach



pH - 6.3
cond - .079
Turb - 0
DO - 8.91
Temp - 15.1
Sal - 0

BH Beach



pH - 5.85
cond - .079
Turb - 0
DO - 9.65
Temp - 14.6
Sal - 0

So End Union Lake

Sd-1

Sd-2 X_{H_2O}

Swimming Sign

X_{soil}

Swimming Sign

Beach Area

pH - 5.9↓
Cond: .093
Turb - 0
DO - 9.4
Temp - 15.3
Sal - 0

Union Lake S+T Club

Sd-D

X_{H_2O}

Sd-U

Club House

X_{soil}

Beach Area

pH - 5.7↓
Cond - .091
Turb - 0
DO - 9.65
Temp - 16.9
Sal - 0

Union Lake T+S club

potable H_2O

pH - ~~7.01~~ 7.0

cond: .061

Turb - 0

DO - 11.50

Temp - 14.8

sal - 0

APPENDIX B
Analytical Report
Vineland Chemical Site
Final Report
May 1999

ANALYTICAL REPORT

Prepared by
Roy F. Weston, Inc.

Vineland Chemical Site
Vineland, Cumberland County, New Jersey

May 1999

EPA Work Assignment No. 3-195
WESTON Work Order No. 03347-143-001-3195-01
EPA Contract No. 68-C4-0022

Submitted to
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EPA-ERTC

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REAC

Prepared by:
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Reviewed by:
M. Barkley

3_195\DEL\AR\9905\VINELANDAR

Table of Contents

Appendix will be furnished on request.

Introduction

REAC in response to WA #3-195, provided analytical support for environmental samples collected from the Vineland Chemical Site located in Vineland, Cumberland County, New Jersey as described in the following table. The support also included QA/QC, data review, and preparation of an analytical report containing a summary of analytical methods, results, and QA/QC results.

The samples were treated with procedures consistent with those specified in SOP #1008.

Chain of Custody	Number of Samples	Sampling Date	Date Received	Matrix	Analysis	Laboratory
03503	5	4/29/99	4/30/99	Water	Arsenic	REAC
	15			Soil		
03504	4			Water		
	2			Soil		

CASE NARRATIVE

Data Package I181

The arsenic (As) percent recoveries for soil samples A19256MS (46%) and A19256MSD (48%) exceeded the QC limits. The As results for soil samples A19251, A19252, A19253, A19255, A19256, A19257, A19259, A19260, A19261, A19263, A19264, A19265, A19267, A19268, A19269, A19274 and A19275 are considered estimated.

Summary of Abbreviations

AA	Atomic Absorption
B	The analyte was found in the blank
BFB	Bromofluorobenzene
BPQL	Below the Practical Quantitation Limit
BS	Blank Spike
BSD	Blank Spike Duplicate
C	Centigrade
D	(Surrogate Table) this value is from a diluted sample and was not calculated (Result Table) this result was obtained from a diluted sample
CLP	Contract Laboratory Protocol
COC	Chain of Custody
CONC	Concentration
CRDL	Contract Required Detection Limit
CRQL	Contract Required Quantitation Limit
DFTPP	Decafluorotriphenylphosphine
DL	Detection Limit
E	The value is greater than the highest linear standard and is estimated
EMPC	Estimated maximum possible concentration
J	The value is below the method detection limit and is estimated
ICAP	Inductively Coupled Argon Plasma
IDL	Instrument Detection Limit
ISTD	Internal Standard
MDL	Method Detection Limit
MQL	Method Quantitation Limit
MI	Matrix Interference
MRL	Method Reporting Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MW	Molecular Weight
NA	either Not Applicable or Not Available
NC	Not Calculated
NR	Not Requested
NS	Not Spiked
% D	Percent Difference
% REC	Percent Recovery
PQL	Practical Quantitation Limit
PPBV	Parts per billion by volume
QL	Quantitation Limit
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SIM	Selected Ion Mode
U	Denotes not detected
W	Denotes weathered analyte, the results should be regarded as estimated.

m	cubic meter	kg	kilogram
L	liter	g	gram
dL	deciliter	cg	centigram
mL	milliliter	mg	milligram
μL	microliter	μg	microgram
ng	nanogram	pg	picogram

* denotes a value that exceeds the acceptable QC limit

Abbreviations that are specific to a particular table are explained in footnotes on that table

Revision 7/9/98

Analytical Procedure for Arsenic in Water

Sample Preparation

A representative 45 mL aliquot of each sample was mixed with 5.0 mL concentrated nitric acid, placed in an acid rinsed Teflon container, capped with a Teflon lined cap, and digested according to SW-846, Method 3015 in a CEM MDS-2100 microwave oven, which was programmed to bring the samples to 160 +/- 4°C in 10 minutes (first stage) and slowly rise to 165-170°C in the second 10 minutes (second stage). After digestion, samples were allowed to cool to room temperature and were transfered to polyethylene bottles. Samples were analyzed for all metals, except mercury, by US EPA SW-846, Method 7000 Atomic Absorption (AA) or Method 6010 Inductively Coupled Argon Plasma (ICAP) procedures.

A reagent blank and a blank spike sample were carried through the sample preparation procedure for each analytical batch of samples processed. One matrix spike (MS) and one matrix spike duplicate (MSD) sample were also processed for each analytical batch or every 10 samples.

Analysis and Calculations

The AA and ICAP instruments were calibrated and operated according to SW-846, Method 7000/7470/6010 and the manufacturer's operating instructions. After calibration, initial calibration verification (ICV), initial calibration blank (ICB), and QC check standards were run to verify proper calibration. The continuing calibration verification (CCV) and continuing calibration blank (CCB) standards were run after every 10 samples to verify proper operation during sample analysis.

The metal concentrations in solution, in micrograms per liter (µg/L) were read directly from the read-out systems of the instruments. ICAP and Mercury results were taken directly from instrument read-outs. The ICAP results were corrected for digestion volume (45 mL sample + 5 mL nitric acid) prior to instrument read-out; AA read-outs (excluding Mercury) were externally corrected for digestion volume (1.1111 * AA read-out).

For samples that required dilution to fall within the instrument calibration range:

$$\mu g/L \text{ metal in sample} = A\ [\ (C+B) / C\ ]$$

where:

A = direct read-out (ICAP and Mercury)
A = corrected read-out (AA)
B = acid blank matrix used for dilution, mL
C = sample aliquot, mL

Results of the analyses are listed in Table 1.1.

Analytical Procedure for Arsenic in Soil

Sample Preparation

A representative 1-2 g (wet weight) sample, weighed to 0.01 g accuracy, was mixed with 10 mL 1:1 nitric acid, placed in a clean beaker and digested in nitric acid and hydrogen peroxide according to SW-846, Method 3050. The final reflux was either nitric acid or hydrochloric acid depending on the metals to be determined. After digestion, the samples were allowed to cool to room temperature and transferred to 100 mL volumetric flasks and diluted to volume with ASTM Type II water. The samples were analyzed for all metals, except mercury, by USEPA SW-846, Method 7000 (Atomic absorption) or Method 6010 (Inductively Coupled Argon Plasma-ICAP) procedures.

A separate sample was used to determine total solids.

A reagent blank and a blank spike sample were carried through the sample preparation procedure for each batch of samples processed. One matrix spike (MS) and one matrix spike duplicate (MSD) were analyzed for each batch or for every ten samples.

Analysis and Calculations

The instruments were calibrated and operated according to SW-846, Method 7000/7471/6010 and the manufacturers operating instructions. After calibration, initial calibration verification (ICV), initial calibration blank (ICB) and quality control check standards were run to verify proper calibration. The continuing calibration verification (CCV) and continuing calibration blank (CCB) were run after every ten samples to assure proper operation during sample analysis.

The metal concentrations in solution, in micrograms per liter (µg/L) were taken from the read-out systems of the Atomic Absorption instruments. The results were converted to milligrams per kilogram (mg/kg) by correcting the reading for the sample weight and percent solids. The ICAP results (mg/kg) were corrected for sample weight prior to instrument read-out; the instrument read-out was then corrected for percent solids.

Final concentrations, based on wet weight are given by:

$$\text{mg metal/kg sample} = [(A \times V)/W] \times DF \times CF$$

where:

A = Instrument read-out (µg/L, AA; mg/kg, ICAP)
V = final volume of processed sample (mL, AA; 1.00 ICAP)
W = weight of sample (g, AA; 1.00 ICAP)
DF = Dilution Factor (1.00 for no dilution)
CF = conversion factor (0.001, AA; 1.00, ICAP)

For samples that required dilution to be within the instrument calibration range, DF is given by:

$$DF = (C+B)/C$$

where:

B = acid blank matrix used for dilution (mL)
C = sample blank aliquot (mL)

Final concentrations, based on dry weight, are given by:

$$\text{mg/kg(dry)} = [\text{mg/kg (wet)} \times 100] / S$$

where

S = percent solids

The results are listed in Table 1.2.

Table 1.2 Results of the Analysis for Arsenic in Soil
WA# 3195 Vineland Chemical Site
Results Based on Dry Weight

Parameter:			Arsenic	
Analysis Method:			AA-Furnace	
Client ID	Location	Percent Solids	Conc mg/kg	MDL mg/kg
Method Blank	Lab	NA	U	0.50
A19251	Almond-S	82.91	0.43	0.39
A19252	Almond-Sd-U	76.51	3.4	0.44
A19253	Almond-Sd-D	80.00	1.9	0.41
A19255	Alliance-S	87.68	0.59	0.41
A19256	Alliance-Sd-U	82.49	10	0.42
A19257	Alliance-Sd-D	85.09	3.4	0.41
A19259	BA Beach-S	99.53	U	0.47
A19260	BA Beach-Sd-U	79.54	6.6	0.41
A19261	BA Beach-Sd-D	77.98	1.7	0.44
A19263	So. End Union Lake-S	99.57	U	0.48
A19264	So. End Union Lake-Sd-U	74.95	11	0.38
A19265	So. End Union Lake-Sd-D	71.90	5.1	0.42
A19267	Union Lake-S	86.25	2.6	0.41
A19268	Union Lake-Sd-U	77.54	6.0	0.47
A19269	Union Lake-Sd-D	82.51	2.8	0.42
A19274	Field Blank-S	100.00	U	0.48
A19275	Field Blank-Sd	100.00	U	0.48

Table 1.1 Results of the Analysis for Arsenic in Water
WA# 3195 Vineland Chemical Site

Parameter:		Arsenic	
Analysis Method:		AA-Furnace	
Client ID	Location	Conc ug/L	MDL ug/L
Method Blank	Lab	U	2.2
A19254	Almond-SW	110	2.2
A19258	Alliance-SW	240	2.2
A19262	BA Beach-SW	11	2.2
A19266	So. End Union Lake-SW	15	2.2
A19270	Union Lake-SW	5.8	2.2
A19271	Union Lake-P	U	2.2
A19272	House #1-P	U	2.2
A19273	House #2-P	U	2.2
A19276	Field Blank-SW	U	2.2

QA/QC for Arsenic

Results of the QC Standard Analysis for Arsenic in Water

The QC standard TMAA#1 was used to check the accuracy of the calibration curve. The percent recovery for the arsenic found in the QC standard listed in Table 2.1, was 97 and within the95% confidence interval limit.

Results of the MS/MSD Analysis for Arsenic in Water

Sample A19258 was chosen for matrix spike/matrix spike duplicate (MS/MSD) analysis. The percent recoveries, listed in Table 2.2, wer 76 and 99. Both recoveries were within QC limits. The relative percent difference (RPD), also listed in Table 2.2, was 27 and outside the QC limits.

Results of the Blank Spike Analysis for Arsenic in Water

The percent recovery for the blank spike arsenic, listed in Table 2.3, was 99 and within QC limits.

Results of the QC Standard Analysis for Arsenic (Soil)

The QC standard TMAA#1 was used to check the accuracy of the calibration curve. The percent recovery for the arsenic found in the QC standard listed in Table 2.4, was 96 and within the 95% confidence interval limits

Results of the MS/MSD Analysis for Arsenic in Soil

Samples A19255, A19256, and A19257 were chosen for matrix spike/matrix spike duplicate (MS/MSD) analysis. The percent recoveries, listed in Table 2.5, ranged from 46 to 83. Four out of 6 recoveries were within QC limits. The relative percent differences (RPDs), also listed in Table 2.5, ranged from 2 to 10. All 3 RPDs were within QC limits.

Results of the Blank Spike Analysis for Arsenic in Soil

The percent recovery for the blank spike arsenic, listed in Table 2.6, was 95 and within QC limits.

Table 2.1 Results of the QC Standard Analysis for Arsenic in Water
WA# 3195 Vineland Chemical Site

Metal	Date Analyzed	Quality Control Standard	Conc. Recovered ug/L	Certified Value ug/L	95 % Confidence Interval	% Recovery
Arsenic	04/30/99	TMAA #1	48.53	50	41.9-55.9	97

Table 2.2 Results of the MS/MSD Analysis for Arsenic in Water
WA# 3195 Vineland Chemical Site

Sample ID: A19258

Metal	Sample Conc µg/L	MS Spike Added µg/L	MS Conc µg/L	MS % Rec	MSD Spike Added µg/L	MSD Conc µg/L	MSD % Rec	RPD	Recommended QC Limits % Rec	Recommended QC Limits RPD
Arsenic	244	55.6	299	99	55.6	286	76	27 *	75-125	20

Table 2.3 Results of the Blank Spike Analysis for Arsenic in Water
WA# 3195 Vineland Chemical Site

Metal	Spiked Conc ug/L	Recovered Conc. ug/L	% Recovery	Recommended QC Limit % Rec
Arsenic	55.6	55.1	99	75-125

Table 2.4 Results of the QC Standard Analysis for Arsenic (Soil)
WA# 3195 Vineland Chemical Site

Metal	Date Analyzed	Quality Control Standard	Conc. Recovered ug/L	Certified Value ug/L	95 % Confidence Interval	% Recovery
Arsenic	05/03/99	TMAA #1	48	50	41.9-55.9	96

Table 2.5 Results of the MS/MSD Analysis for Arsenic in Soil
WA# 3195 Vineland Chemical Site
Results Based on Dry Weight

Sample ID: A19255

Metal	Sample Conc mg/kg	MS Spike Added mg/kg	MS Conc mg/kg	MS % Rec	MSD Spike Added mg/kg	MSD Conc mg/kg	MSD % Rec	RPD	Recommended QC Limits %Rec	RPD
Arsenic	0.587	4.04	3.61	75	4.19	3.79	76	2	75-125	20

Table 2.5 (cont.) Results of the MS/MSD Analysis for Arsenic in Soil
WA# 3195 Vineland Chemical Site
Results Based on Dry Weight

Sample ID: A19256

Metal	Sample Conc mg/kg	MS Spike Added mg/kg	MS Conc mg/kg	MS % Rec	MSD Spike Added mg/kg	MSD Conc mg/kg	MSD % Rec	RPD	Recommended QC Limits %Rec	Recommended QC Limits RPD
Arsenic	10.4	4.36	12.4	46 *	4.39	12.5	48 *	4	75-125	20

Table 2.5 (cont.) Results of the MS/MSD Analysis for Arsenic in Soil
WA# 3195 Vineland Chemical Site
Results Based on Dry Weight

Sample ID: A19257

Metal	Sample Conc mg/kg	MS Spike Added mg/kg	MS Conc mg/kg	MS % Rec	MSD Spike Added mg/kg	MSD Conc mg/kg	MSD % Rec	RPD	Recommended QC Limits %Rec	RPD
Arsenic	3.44	4.29	6.99	83	4.32	6.66	75	10	75-125	20

Table 2.6 Results of the Blank Spike Analysis for Arsenic in Soil
WA# 3195 Vineland Chemical Site

Metal	Spiked Conc mg/kg	Sand Blk Conc. mg/kg	Recovered Conc. mg/kg	% Recovery	Recommended QC Limit % Rec
Arsenic	4.95	U	4.71	95	75-125

REAC, Edison, NJ
(908) 321-4200
EPA Contract 68-C4-0022

CHAIN OF CUSTODY RECORD

Project Name: Vineland Chemical
Project Number: 03347-143-001-3195-01
RFW Contact: Jen Boyce Phone: 732-494-4004

No: 03503

SHEET NO. 1 OF 2

043099-

Sample Identification

Analyses Requested

REAC #	Sample No.	Sampling Location	Matrix	Date Collected	# of Bottles	Container/Preservative	Arsenic
-109	A19251	Almond - S	S	4/29/99	1	8 oz. jar / 4°C	✓
110	A19252	Almond - Sd - U	Sd				
111	A19253	Almond - Sd - D	Sd				
112	A19254	Almond - SW	SW			1 L poly / HNO3	
113 *	A19255	Alliance - S	S			8 oz jar / 4°C	
114 *	A19256	Alliance - Sd - U	Sd				
115 *	A19257	Alliance - Sd - D	Sd				
116 *	A,B,C 19258	Alliance - SW	SW		3	1 L poly / HNO3	
117	A19259	BA Beach - S	S		1	8 oz jar / 4°C	
118	A19260	BA Beach - Sd - U	Sd				
119	A19261	BA Beach - Sd - D	Sd				
120	A19262	BA Beach - SW	SW			1 L poly / HNO3	
121	A19263	So. End Union Lake - S	S			8 oz jar / 4°C	
122	A19264	So. End Union Lake - Sd - U	Sd				
123	A19265	So. End Union Lake - Sd - D	Sd				
124	A19266	So. End Union Lake - SW	SW			1 L poly / HNO3	
125	A19267	Union Lake - S	S			8 oz jar / 4°C	
126	A19268	Union Lake - Sd - U	Sd				
127	A19269	Union Lake - Sd - D	Sd				
128	A19270	Union Lake - SW	SW			1 L poly / HNO3	

Matrix:

SD -	Sediment	PW -	Potable Water	S -	Soil
DS -	Drum Solids	GW -	Groundwater	W -	Water
DL -	Drum Liquids	SW -	Surface Water	O -	Oil
X -	Other	SL -	Sludge	A -	Air

Special Instructions:

* MS/MSD

QA: R

FOR SUBCONTRACTING USE ONLY

FROM CHAIN OF CUSTODY #

Items/Reason	Relinquished By	Date	Received By	Date	Time
all/analysis	Michelle Clayton	4/29/99	David Angweyi	4/30/99	830

Items/Reason	Relinquished By	Date	Received By	Date	Time
All/Analysis	David Angweyi	4/30/99	[illegible]	5/1/99	7:00

FORM #4

8/94

REAC, Edison, NJ
(908) 321-4200
EPA Contract 68-C4-0022

CHAIN OF CUSTODY RECORD

Project Name: Vineland Chemical
Project Number: 03347-143-001 3195-01
RFW Contact: Jen Royce Phone: 732-494-4004

No: 03504

043099-

SHEET NO. 2 OF 2

Sample Identification

Analyses Requested

REAC #	Sample No.	Sampling Location	Matrix	Date Collected	# of Bottles	Container/Preservative	Arsenic
129	A19271	Union Lake - P	PW	4/29/99	1	1L poly / HNO3	✓
130	A19272	House #1 - P	↓	↓	↓	↓	↓
131	A19273	House #2 - P	↓	↓	↓	↓	↓
132	A19274	Field Blank - S	S	↓	↓	8 02 jars / 4°C	↓
133	A19275	Field Blank - Sd	Sd	↓	↓	↓	↓
134	A19276	Field Blank - Sw	Sw	↓	↓	1L poly / HNO3	↓

Matrix:

SD -	Sediment	PW -	Potable Water	S -	Soil
DS -	Drum Solids	GW -	Groundwater	W -	Water
DL -	Drum Liquids	SW -	Surface Water	O -	Oil
X -	Other	SL -	Sludge	A -	Air

Special Instructions:

QA: JR

FOR SUBCONTRACTING USE ONLY

FROM CHAIN OF CUSTODY #

Items/Reason	Relinquished By	Date	Received By	Date	Time
all analysis	Michelle Chapman	4/30/99	David Angwenyi	4/30/99	830am

Items/Reason	Relinquished By	Date	Received By	Date	Time
ALL Analysis	David Angwenyi	4/30/99	[illegible]	4/30/99	9:00

FORM #4

8/94